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PUBLIC WORKS MINISTRY.

REPORT

UPON THE

ADMINISTRATION OF THE PUBLIC WORKS DEPARTMENT

FOR 1901

BY

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UNDER SECRETARY OF STATE FOR PUBLIC WORKS DEPARTMENT

WITH REPORTS BY THE OFFICERS IN CHARGE OF THE SEVERAL BRANCHES OF THE ADMINISTRATION

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PUBLIC WORKS DEPARTMENT.

ADMINISTRATIVE REPORT FOR THE YEAR 1901.

The present Report contains a, more or less, summary account of Public Works Administration for the year 1901. To it, I have attached, as Appendices, the Reports addressed to me by the heads of the different Services depending upon the Ministry of Public Works. Each of these Reports is full of detailed information regarding the many different subjects discussed.

The following is a list of the Reports appended to my own:—

I.—*The Irrigation Branch.*

(*a*) Report by Mr. K. Verschoyle, Inspector General of Irrigation, Upper Egypt.
(*b*) Report by Major Brown, C.M.G., Inspector General of Irrigation, Lower Egypt.
(*c*) Report by Mr. A. L. Webb, Director General of the Nile Reservoir Works.

II.—*Works other than Irrigation.*

(*d*) Report by Mr. A. H. Perry, Director General of Towns and Buildings.
(*e*) Report by Captain H. G. Lyons, Director General of the Survey Department.
(*f*) Report by Mohamed Bey Anis, Chief of the Technical Service.
(*g*) Report by Monsieur G. Maspéro, Director General of the Antiquities Department.
(*h*) Report by Mr. A. J. Cotterill, Engineer in Chief of the Railway Administration, and Acting Inspector to the Ministry of Public Works, for the Agricultural Railways.

EXPENDITURE.

The following tables show the total sums expended, under the Public Works Budget, in 1901:—

TABLE I.

ORDINARY BUDGET.

	£E.	Mill.
Central Office charges...	42672	051
Irrigation Branch...	632961	725
Towns and Buildings	228356	025
Survey Department	21714	872
Technical Service...	14412	899
Antiquities Service	12335	355
Total... ...	£E.952452	927

The total is less, by £E.15990,479 mill. than that of the year 1900. This large reduction is due to the fact, that the expenditure upon Agricultural Roads, in 1901, was comparatively small, whereas in 1900 it reached the figure of £E.39564,994. This charge is included in the item "Irrigation Branch," in the above table.

In June, 1901, the Government Zoological Gardens were transferred from the Ministry of Finance to the Ministry of Public Works. The expenditure for the year, was not, however, entered in the Budget of the latter Ministry, and does not therefore appear in last year's accounts.

TABLE II.

EXTRAORDINARY BUDGET, OR NEW WORKS EXECUTED UNDER SPECIAL CREDITS.

	£E.	Mill.
New Weirs at Barrage (money granted by the Caisse)...	8321	810
Zifta Barrage (money granted by the Caisse)	121059	338
Drainage Works (money granted by the Caisse)	139011	755
Irrigation Improvements (money granted by the Caisse)	319748	060
Public Buildings (money granted by the Caisse)	183534	222
Public Buildings (money found by other Departments).	14311	490
Total... ...	£E.904782	716

This is more than the expenditure in 1900, under the same head, by £E.271275,754 mill.

In addition to the expenditure shown in Table II, certain further sums were spent upon miscellaneous works, not included in the above table. The credits for these works were derived from various sources.

I have, as in last year's Report, grouped these items of expenditure into a separate Table, which I have called "Various Extra Credits."

TABLE III.

Various Extra Credits.

	£E.	Mill.
Special Low Nile (money granted by Caisse de la Dette)	9622	335
Dredging Mahmudyieh Canal (money granted by Caisse de la Dette)	1117	818
Rosetta and Damietta Sudds (money granted by Caisse de la Dette)	12933	339
Egyptological Museum Catalogue (money granted by Caisse de la Dette)	1860	394
Restoration Karnak Temples (money granted by Caisse de la Dette)	2186	677
Survey (Revenue) (money supplied by Finance Ministry)	20173	000
Cutting Sudd in White Nile (money supplied by Finance Ministry)	2311	484
Maintenance Barrage Gardens (money supplied by Finance Ministry)	763	439
Cairo City (money supplied by Finance Ministry) ...	4495	077
Provincial Towns (money supplied by Finance Ministry)	29	112
Roads (Cairo) (money supplied by Finance Ministry)...	6351	216
Ezbekieh Gardens (Cairo) (money supplied by Finance Ministry)	14	588
Total... ...	£E.61858	479

The expenditure in this table is less than that for the previous year, by £E.9228,237 mill.

The following table gives the summary of the year's expenditure:—

TABLE IV.

Total Expenditure in 1901.

	£E.	Mill.
Ordinary Budget...	952452	927
Extraordinary Budget	904782	716
Various extra credits	61858	479
Total	£E.1919094	122

This expenditure exceeds that of the previous year, by £E.246057,038 mill.

The above does not include the payments made to Sir John Aird & Co. for the Nile Reservoir Works.

The total value of work executed, in this connection, in 1901, was £859447, or £E.837960,825 mill.

Adding this to the figures given in Table IV, the expenditure controlled by the Ministry of Public Works, in 1901, attains a total of £E.*2757054,947* mill.

In discussing the progress made by the several Services in 1901 I have, as has always been my custom, separated my Report into two portions, viz., "Irrigation Works" and "Works other than Irrigation."

Part I.—THE IRRIGATION SERVICE IN 1901.

THE NILE SUPPLY.

The year 1901 followed closely upon the lines of 1900, inasmuch as the supply in the Nile, both in summer and in flood, was considerably below the average. As the river levels, up to the time of writing, appear to indicate that the summer supply of 1902, will be an equally poor one, it would seem as if Egypt were, at present, passing through a cycle of dry years.

The utmost that can be said with regard to last year's supply is that is was better than that of the year previous. Nevertheless, it was much below the average. As the Aswan river-gauge is still the main register of reference to Egyptians, all description of the Nile levels of 1901, has been referred to it.

On the 1st January, 1901, the Aswan gauge recorded a level of 0·67 metres lower than the mean of 20 years, but at the same time, 1·08 metres above that of the same date, in 1900.

The fact is worth recording, that whereas, in 1900, public opinion was much agitated by the low state of the river, and disastrous speculation in cotton was indulged in ; in 1901, on the contrary, no alarm was manifested, and speculation was confined to the legitimate operations of the cotton market. It may fairly be claimed by the Irrigation Service that the absence of all panic, in 1901, was due to the knowledge that, in spite of the abnormal water-levels of 1900, it had successfully saved a very large crop of cotton in that year.

During the early months of 1901, the fall in the river was so rapid that, at one time, there were good grounds for fearing that the supply would be as bad as that of 1900 and perhaps even worse. Happily, these apprehensions were not realised. Although last year's Nile must take a place in the category of "very poor" ones, and although special measures were necessitated for the preservation of the summer crops, the difficulties of water distribution were in no way as great as was the case in 1900.

Allusion has been already made to the January water-levels at Aswan. In the month of May, a considerable improvement took place, and on the 1st of June, this gauge registered a height, only 0·14 metres below the normal levels for that season of the year. This improvement was not, however, maintained, and on the 1st of July, the Aswan level was, again, below the average, to the extent of 0·75 metres. This difference still further increased with the flood, and on the 1st of August, the level was 1·28 metres below the mean for that period of the year. Throughout the flood, the Aswan water-levels were below the average; on the 20th of August, the difference being 0·10 metres, and on the 30th of the same month, 0·47 metres.

Between this last date and the 6th of September, a timely rise, of 0·47 metres, was recorded, and, most opportunely, the fall of the river, from that date to the 20th of September, was a very gentle one. From this last date, on the contrary, it was very rapid indeed, and on the 31st of December, 1901, the Aswan gauge stood at R.L. 86·88, or 0·79 metres below the normal level. With the exception of the bad years of 1888 and 1899, this level is the lowest yet recorded, for the date in question.

To sum up: the summer water-levels of 1901, averaged 0·70 metres below the normal, except for the period between the middle of May and the middle of June. The flood began to rise early, and, at first, promised well, but the promise was never fulfilled, and the rise was at no time a strong one. What saved the situation, was the second rise which took place in the first days of September, and the subsequent gentle fall, up to the end of the third week of that month. This much assisted the irrigation of the Basins of Upper and Middle Egypt. The cause of the flood of 1900, being such a bad one, was, that the maximum level was attained very early, viz., on the 19th of August. This date was only a few days after that upon which the basin canals had been opened, to admit of the entry of the flood water. As this maximum was followed by a continuous and rapid fall, the operation of filling the different basin chains, and bringing them to full supply level, was an extremely difficult one. In 1901, as has been shown, there was a rise in September, and a very slow fall in the levels for some three weeks later.

Mr. Verschoyle, in his attached Report, gives a long and detailed description of the measures taken for securing the irrigation of the different systems of basins, and for discharging the water back into the river. This Report is full of interesting information, based upon the experience of last year, and will be of great value to those charged, in the future, with similar operations. I will only mention here, that the filling of the basins commenced, generally, between the 8th and 18th of August. "Tammam Rai," or full irrigation, was generally reached in Upper and Middle Egypt by the 25th of September, although in Beni-Suef, some basins were as late as the 3rd of November. The "Sarf," or discharge of the basins, commenced generally on the 1st of October. In the southern basins it was completed by the first week of November, and in those furthest north, by the 19th of that month.

With regard to the early summer irrigation, i.e, prior to the flood: as regards Middle Egypt, there were no special difficulties to record. The rise during May and June, and the early commencement of the flood, helped the perennially-irrigated lands through the period of stress. The obstruction caused by the Asyut Weir, also rendered considerable assistance to the supply of the Ibrahimieh Canal, and although every endeavour was made to secure a fair distribution of water between Middle and Lower Egypt, there is, I think, little doubt that the former area profited, to a certain extent, at the expense of the latter.

Rotations were enforced between the months of March and August; the earliest commencing on the 13th of March, and the latest, being continued (in Beni Suef) to the 26th of August.

These rotations were of three classes, increasing in severity, as the river fell.

The periods varied from one watering, in sixteen days, to one, in twenty-six days.

The usual rotations, upon machines for raising water, were imposed between the 10th of April and 10th of July.

Briefly stated, it may be said that the Irrigation season of 1901, in Upper and Middle Egypt, was characterized by a fairly easy summer (considering the low state of the river), but by a very difficult flood.

Turning to Lower Egypt, we find that the contrary was the case. The summer supply was poor, and the difficulties of water distribution considerable. During the flood (although a poor one) there was no special difficulty in arranging for the irrigation of the lands.

The Barrage once more proved its value, as did the new weirs in connection with it. It is not too much to say, that these combined structures saved the Lower Egypt cotton crop. In the month of February, by regulating on the Barrage, favourable levels were produced. At that period, a sudden demand invariably arises for the irrigation of the winter crops, after the annual closure of the canals for clearance. Very shortly after this, the watering of land for the cotton sowings, commences, and it is indispensable to be able to provide a plentiful water-supply at this season of the year.

In the month of July, when the pressure and strain were at their highest, the upstream water-level at the Barrage, was raised to

R.L. 15·50, or 1½ metres higher than would have been possible, prior to the construction of the weirs and the raising of the Barrage gates.

In 1901, this level was reached on the 21st of July, whereas in former years, it was never attained before the middle of August, or even later.

On the Barrage, as formerly constructed, it was unsafe to raise the upstream level (above a certain height) until sufficient water had passed down each branch and thus raised the level downstream so that the head on the structure did not exceed 4·0 metres. Even this was risky. Consequently, the first rise of the flood was practically wasted for irrigation purposes, except for giving a supply to the pumps situated on the two branches of the river. Now, until the upstream level of 15·50 is reached, no water is allowed to pass down either branch of the river below the Barrage, and every drop brought down by the first rise is passed into the canals taking off above it. Further, the level of 15·50, once reached, is maintained. The advantages to the canal discharges and to the irrigation of Lower Egypt are obvious.

The maximum head on the Barrage and weirs, was attained on the 21st of July.

In the Rosetta Branch, the total head was 5·78 metres, and in the Damietta Branch, 5·45 metres.

This head was divided as follows :—

BRANCH.	Head on Barrage.	Head on Weir.	Total head.
	Metres.	Metres.	Metres.
Rosetta	2·89	2·89	5·78
Damietta	3·02	2·43	5·45

It will thus be seen, that, although the water-level, upstream of the Barrage, was 1·5 metres *higher* than would have been possible, before the construction of the Weirs, yet the maximum head, thrown upon either portion of the structure, was not more than 3·02 metres. This last was only maintained for two or three days.

It may safely be asserted that, no work, undertaken of late years, has proved of more value to the irrigation of Lower Egypt than the construction of these subsidiary weirs. They have immensely increased the utility of the Barrage itself.

In consequence of the low river, similar precautionary measures were introduced, in the interest of the summer crops, as was the case in 1900.

The earthen dams, in the northern reaches of the Damietta and

Rosetta Branches, were again constructed, in order to prevent the ingress of the sea-water.

The Khedivial Decree, prohibiting the irrigation of land for maize sowings, until such date as permitted by the Ministry of Public Works, was again issued. Severe Rotations were imposed upon the canals, although not quite as severe, in respect to length of closure, as was the case in 1900. The sowing of rice, except in certain selected localities, was practically prohibited, inasmuch as the rotation programmes were so framed, as to secure the cotton crop before every thing, and at the expense of the rice crop.

The pumps at Atfeh, on the Rosetta Branch, were worked, for some time, so as to increase the supply in the Mahmudiyeh Canal.

A special credit, for the Low Nile, was asked for, and granted by the Caisse de la Dette.

These measures may be briefly described.

The Damietta and Rosetta "Sudds."

The Damietta Branch "Sudd" was completely closed, by the 11th of April. On its completion, the river, at Damietta, rose half a metre above sea-level.

This "Sudd" cost £E.4746.

Major Brown, in his attached Report, states that the site, hitherto used for this "Sudd," is not a good one. The river bed, upstream, is full of deep holes, which, before the "Sudd" is made, are full of salt water. It is impossible to get rid of, even by the expedient of sending a flush down the river, before the "Sudd" is closed. When, in the later summer months, the pond upstream of the "Sudd" has been drained by the pumps, the level falls, and the whole reach becomes impregnated by the reservoirs of salt water contained in the above-mentioned holes.

He, consequently, proposes to change the site and place the dam considerably further upstream.*

The Rosetta Branch "Sudd," at Mehallet El-Amir, cost £E.8187. It was commenced on the 10th of January and closed by the end of March. This dam was, in 1901, raised higher than usual, so that it held up 2¼ metres of water. This innovation, which was due to Mr. Dupuis, the Inspector of Irrigation, produced excellent results. The upstream water-levels of the river were raised sufficiently to permit of water flowing, by gravitation, into the northern supply canals. The country on both sides of the Nile, in the neighbourhood of Rosetta, received a better supply of water than had ever before been the case during the summer months.

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*This has been done in 1902. The Damietta "Sudd" has been constructed near to Feraskur, and has been made, high enough and strong enough, to resist a head of water.

A similar measure was not possible upon the Damietta Branch, owing to the position of the dam. The villages lying to the extreme north, notably Ezbet El-Burg and Ras El-Bar, suffered, for a time, severe straits for want of drinking water, more particularly as the springs in the river bed failed, as usual, towards the end of the season.

Special endeavours were made to force water down the supply canals to this region, but serious temporary inconvenience was undoubtedly felt by the inhabitants. The town of Damietta was better off, as it is supplied with a large reservoir, or cistern, for drinking water, but it too, felt the pressure to a certain extent. The Irrigation Service is making special arrangements for 1902, which it is hoped will result in giving these towns a better water-supply. A Reservoir for drinking water is under construction at Ezbet El-Burg.

Canal Rotations.

The programme was, as in 1900, a three-fold one, each new change being more severe than the last. The maximum period of closure was, however, less than that fixed for the year before. In 1900, the severest programme allowed for one watering in twenty-eight days, while in 1901, the maximum was twenty-one days.

It was originally intended to apply the Rotations from the 7th of April, but the river levels turning out more favourable than had been anticipated, they were not applied until the 17th of May.

In 1901, they commenced on the 14th of April. The last Rotations were removed on the 17th of August. Major Brown, in his Report, discusses the whole principle of canal rotations, and their application to water distribution, at some length. His remarks are most interesting, and are based upon a close knowledge of the subject. Want of space prevents me from doing more than making allusion to them here.

Rice Cultivation.

Major Brown also discusses the burning question of giving water to the rice lands, and considers that "the washing of the land, in a bad "year, is an utterly unjustifiable luxury, when carried out at the expense "of the cotton crop." He again urges the substitution of "Sabaini" for "Sultani" rice. He quotes the opinions of two of his Inspectors, to the effect that, even when water has been allowed for rice, the people have taken but little advantage of the permission, preferring to cultivate cotton. This may be so, but nothing can alter the fact that there are large areas of land in the north of the Delta, which, at present, are unfit for any cultivation but that of rice. The continual washing of these lands in summer, by clear water, removes the salt from the soil. Such lands could not stand cotton continuously, for a period of years, and unless rice is grown on them, they will, inevitably, become salted and must, eventually, be thrown out of cultivation.

In spite of the higher value of cotton, as a crop, over rice, these poor lands have an equal right to water with those situated in more favoured tracts. In years of exceptionally poor supply, like those of 1900 and 1901, it will probably be impossible to give them water, but, in any ordinary years, the landowners ought, in my opinion, to be allowed to cultivate rice, notwithstanding that their doing so may render water-distribution difficult, and may even possibly cause a slight diminution in the yield of cotton. Further, I consider that the people concerned should, themselves, be given the choice of deciding whether they will cultivate "Sultani" or "Sabaini" rice in their lands. It is to be hoped that the completion of the Assuan Reservoir may, in the future, obviate the necessity of prohibiting rice planting, generally.

The "Sharaki" Decree.

The prohibition against planting Maize, was removed upon the 12th of July. Unfortunately, the river, at that moment, did not rise as quickly as was expected and difficulties ensued. This date, under actual conditions, was a week too early. It might have been postponed until the 20th of July, without any risk to the Maize crop, which was an excellent one.

The Afteh Pumps.

These worked intermittently until the 17th of August. The level, at the tail of the Mahmudiyeh Canal, was kept 80 per cent higher than the normal gauge for the summer season. Consequently, the water-supply of Alexandria was more satisfactory than usual.

Special Low Nile Credit.

A grant of £E.13000 was made by the Caisse de la Dette, to meet the special measures required by the low Nile. Of this, a sum of £E.9822,332, only, was expended.

Barrage Levels.

The minimum water-level recorded upstream of the Barrage in 1901, was 13·58 metres, on the 26th of June. The levels then rose gradually, until the 22nd of July, when, as has been stated, 15·50 was reached and maintained.

The opening of the Barrage took place gradually, after the last date, and by the 19th of August, all the gates were fully open. The Barrage, as has been the case for some years, was regulated upon during a portion of the flood. Major Brown describes the measures in detail, and I would refer any one desiring further information on this subject, to his report.

Flood Levels at Rodah.

Although the flood was poor, Lower Egypt did not suffer much inconvenience thereby and had not much to complain of as compared with other similar years. The maximum height reached at Rodah (Cairo) was 21 pics 8 kirats, on the 25th of September. No artificial "wave" was produced last year by means of the basins, but, except for 1200 feddans unflooded in East Giza, and an inconsiderable area of island, south of the Barrage, all the high lands received water. The "wave" in question cannot be produced in bad years, except by sacrificing to some extent, the interests of Upper, to those of Lower Egypt.

"Sharaki."

The total area left unflooded in 1901, on account of the low levels attained by the flood, amounted to 9000 feddans. In addition to this, an area of 3500 feddans was unirrigated during the flood, but produced a winter-crop later. The corresponding areas for the year previous, were 14561, and 4477 feddans, respectively. By far the greater portion of the above area, was situated in Upper and Middle Egypt, most of it being on islands and foreshores, impossible to protect.

Mr. Verschoyle gives a long list of works, necessary to improve the flood irrigation of Upper Egypt. These works are 72 in number, but are most of them small. They will gradually be carried out from the funds available, in the future, from the Regular Budget.

In Giza Province, £E.267, was spent in irrigating 2022 feddans of unflooded land.

In Behera, £E.1093, was expended, for the same purpose, upon an area of 4000 feddans.

CROPS IN 1901.

The Cotton Crop.

In spite of the low summer supply, the cotton crop of 1901, was an exceptionally large one and promises to equal the record crop of 1897, which amounted to 6,513,444 kantars.*

The latest official returns, of last year's crop, give a total of 6,466,325 kantars, and as there is still a certain quantity of cotton yet to be brought in to Alexandria from the Provinces, it seems probable that the total figures for the year will reach 6½ million kantars. At one time, the crop promised to be exceptionally large, but, as was the case in 1900, fogs and cold weather prevailed during the month of September, and lessened the yield very considerably.

The following is the comparison with the crops of previous years :—

YEAR.	Amount of Crop in kantars.	Average price reached per kantar for the whole season.
		P.T.
1888	2,699,103	272·5
1889	3,200,000	268·0
1890	4,100,000	227·0
1891	4,500,000	178·0
1892	5,200,000	187·0
1893	5,200,000	178·5
1894	4,550,000	192·5
1895	5,203,650	223·9
1896	5,785,532	191·5
1897	6,513,444	162·9
1898	5,579,602	183·2
1899	6,432,776	258·2
1900	5,435,480	267·7
1901	6,500,000	217·8

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* A kantar of ginned cotton = 99·049 lbs.

The average price, per kantar, ruled considerably lower than either in 1899, or 1900. In September and October, it averaged 209·37 P.E., falling, in November, to 197·5 P.E. the kantar. It then rose and continued at over 210 P.E., up to the end of February, when a sharp rise occurred, which in May, reached the high figure of 258·1 P.E per kantar. This rise was not of material benefit to the small agriculturist, who is, as a rule, forced to sell his cotton early in the season.

Major Brown works out the mean yield of cotton, per feddan, to be 5½ kantars. He obtains this from figures supplied by the Ministry of Finance, which represent the total area under cotton, to be 1,249,883 feddans. This average rate of yield appears to be excessive. Few, even of the best, estates produce an average yield of more than 6 kantars per feddan, and in large areas of mingled rich and poor land, it is doubtful if an average of more than 3 kantars, the feddan, is produced. In my opinion, the average yield, all over Egypt, can scarcely exceed 4, or 4½ kantars, per feddan. If I am right, then the area planted with cotton must be far greater than that officially given, and this, I feel convinced, must be the case.

The Sugar-Cane Crop.

The area planted with cane was the largest on record.

Two factories did not work in 1901, viz., that of the Egyptian Sugar and Land Co., and that of Beni Korrah.

The former sent all the cane, raised on its pumping station, to the "Société Générale des Sucreries de la Haute Egypte."

The following statement gives the quantity of cane crushed and the out-turn of sugar, class No. 1, in the principal factories, for the last six years :—

Factories.	Season 1896-1897.			Season 1897-1898.			Season 1898-1899.			Season 1899-1900.			Season 1900-1901.			Season 1901-1902.		
	Cane crushed.	Out-turn No. 1 sugar.	Percentage.	Cane crushed.	Out-turn No. 1 sugar.	Percentage.	Cane crushed.	Out-turn No. 1 sugar.	Percentage.	Cane crushed.	Out-turn No. 1 sugar.	Percentage.	Cane crushed.	Out-turn No. 1 sugar.	Percentage.	Cane crushed.	Out-turn No. 1 sugar.	Percentage.
	Kantars.	Kantars.		Kantars.	Kantars.		Kantars.	Kantars.		Kantars.	Kantars.		Kantars.	Kantars.		Kantars.	Kantars.	
Daira Sanieh. ..	15.815.112	1,590,352	10·1	14,478,346	1,230.373	8·5	13,680,944	1,253,525	9·2	14.515,568	1,369,953	9·4	11,850.485	1.161.471	9·8	12.442,452	1,245.843	10·01
Daira Sultan Pasha.	587,467	53,589	9·1	451,390	36.510	8·1	479,822	43.885	9·1	466,027	42.059	9·2	524.466	49.469	9·4	(a) 410.465	40.230	9·75
Société Générale des Sucreries de la Haute-Egypte.	3.799.962	39,551	10·4	5,098,896	404,434	8·0	6,250,320	604,002	9·6	5,978,871	375.409	9·6	6.908,772	682.587	9·88	7.494.420	645.060	8·6
Egyptian Sugar & Land Company.	—	—	—	—	—	—	546,355	49,338	9·3	504,336	46,608	9·2	850,500	81,810	9·6	—	—	—
Beni-Korrah	410,000	34,000	8·3	270,000	18,000	6·7	—	—	—	504,337	46.608	9·2	—	—	—	—	—	—
Totals..	20,612,541	2,073,492	10·1	20,298,317	1,689,317	8·3	20,957,441	1,950,750	9·3	21,969,136	2,080.637	9·4	20,134,223	1.975,337	9·8	20,506,465	1.928,886	9·4

(a) 54,547 kantars were crushed for molasses.

The area planted with sugar cane, on the Ibrahimiyeh Canal, was 48093 feddans, and by pumps direct from the river (south of Assiout) was 14522 feddans.

The former area was larger than that of the year previous, but less than that of the years 1898 and 1899. The area, south of Assiout, was less than that of 1900.

As Mr. Verschoyle points out, a big cotton crop, means a proportionately smaller sugar crop.

"*Kedi*," *or Summer Dhurra.*

The area under this crop in still increasing.

Thus in 1899 it was 87766 feddans.
,, 1900 ,, 96547 ,,
and in 1901 ,, 97053 ,,

Last year's crop was a very good one, and "Kedi" is one of the most profitable crops to raise, as the price obtained is always a high one.

The Maize Crop.

This was excellent throughout Egypt.

The Rice Crop.

Owing to the scarcity of water, this crop, as in 1900, was a very small one.

The Winter Crops.

These were again good, and the prices ruled high.

Mr. Verschoyle, in his Report, gives an interesting table of the areas under different crops in Upper Egypt, an example which might be advantageously followed for Lower Egypt.

DUTY OF WATER.

Both the Inspectors General of Irrigation discuss this important subject, in some detail. The "duty" for Upper and Lower Egypt works out as follows :—

UPPER EGYPT.

PROVINCES.	DUTY ON MEAN DISCHARGE — Cubic metres of water, per feddan irrigated.
Asyut, Minia, Beni-Suef and Fayum taken (together) .	26·5
Minia and Beni-Suef (together)	26·4
Beni-Suef (alone)	23·6
Fayum (alone)	24·0
Minia (alone)	30·6

Mr. Verschoyle also gives the figures for the "Duty," calculated upon the minimum discharge, but, as he states that he attaches no value to them, I do not repeat them here.

LOWER EGYPT.

In these figures, rice has been deducted and, as usual, calculated at 40 metres cube per feddan. These "duties" are then, for summer crops other than rice, as follows :—

PROVINCES.		DUTY ON MEAN DISCHARGE — Cubic metres of water per feddan irrigated.
Eastern Provinces.—	Kaliubia, Sharkia and Dakahlia.	27·78
Central ,,	Menufiyeh and Gharbieh	25·00
Western ,,	Behera	26·89

The above figures have been worked out from the discharges measured at the Barrage, and the "Sefi" area, as given by the Finance Ministry. The "duty" for the "Sefi" crops of the whole of Lower Egypt, excluding rice, equals 26·82 metres cube per feddan irrigated.

Comparing these "duties" with those recorded for 1900, it will be seen that this year's figures, for Upper Egypt, correspond very closely with those of the preceding year.

In Lower Egypt, on the contrary, there is a remarkable difference, the "duty," throughout, being considerably lower than was the case in 1900. Now the year 1900, was one of exceptionally low supply. Consequently, extremely severe rotations were imposed, and special precautions were taken to prevent any waste of water. It is natural to suppose that, under such exceptional circumstances, the "duty" of the water would be higher than would ordinarily be the case.

Even this explanation scarcely accounts for the difference however, but Major Brown points out how very difficult it is to calculate the actual "duty" of the water, wherever rice-irrigation has to be considered.

Theoretically, we allow 40 metres cube per feddan, for this crop, but the people really take as much as they can get, and the amount is probably much more than the above.

In the year 1900, rice was prohibited altogether, and the element of uncertainty was consequently absent. In 1901, the cultivation of rice was permitted, although on a limited scale.

Taking every thing into consideration, the "duties," for the past two years, appear to have been very carefully calculated, and the figures are certainly more accurate than any of those previously given. Major Brown's remarks upon this subject are of much interest. His Report deals with this question in considerable detail.

River Gauges in the Soudan.

Advantage was taken of my visit to the upper reaches of the White Nile, in the spring of 1901, to erect a proper set of Nile gauges, for recording the rise and fall of this river.

Iron gauges, registering metres and centimetres, were erected at Gondokoro, Taufikia and El Duem. The registers of these gauges will, in time, afford valuable information regarding the regimen of this very important source of the Nile.

Lake Victoria Nyanza Gauges.

As Lord Cromer, in his Report upon the Administration of Egypt in 1901,* has quoted my remarks upon the above, in full, I will merely recopy these observations here, with a few additional remarks.

The months of October and November, being those of lowest levels, in this lake, the 1st of the former month, has been selected as a convenient date for making a comparison between the levels of different years.

Owing to the Rebellion, there is a want of continuity in the records. The break lasts from the 1st of August, 1897, to the 1st of September, 1898. As the readings, prior to and subsequent to the Rebellion, are not referred to one common datum, no comparison between the two sets of records is possible. The following remarks, consequently, refer only to the registers commencing with September 1898, when the new gauges were erected.

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* Foreign Office Blue-Book—Egypt No. 1 (1902).

It may be remembered that, in my last year's Report, I pointed out, that the lake levels had been falling continuously, for three consecutive years, and that, on the 1st October 1900, they were, as far as our knowledge of the lake went, abnormally low. These levels are repeated here for reference, with the addition of those for 1901. The readings of the Port Alice gauge have not yet been received.

DATE OF READINGS.	Port Alice, or Entebbé.		Port Victoria and Ugowé, or Kusumu.		Lubwas, or Usoga.	
	Ft.	In.	Ft.	In.	Ft.	In.
1st October, 1898... ...	3	2	3	2½	3	1½
1st October, 1899... ...	2	6½	2	2	1	5
1st October, 1900... ...	1	7	1	1	1	0
30th September, 1901...	Not yet received.		1	8	1	6

At one period, during 1901, the lake rose very considerably, as the following maximum levels, taken from the register, prove:—

Port-Alice.		Ports Victoria and Ugowe.		Lubwas.	
19th to 21st May.		5th June.		31st May.	
Ft.	In.	Ft.	In.	Ft.	In.
5	2½	3	11½	3	1½

These show a total rise, over the levels of the same dates in 1900, of 2 feet 7 inches at Port-Alice; 1 foot 8½ inches at Port Victoria; and 1 foot 8½ inches at Lubwas. The difference between the gauge readings at Port-Alice (both as regards date and height of maximum levels) and those of the other two stations, is most remarkable. It is possibly due to the action of wind, or to local storms, but it would almost appear as if an error, of some sort, had crept into the register. Be this as it may, the result of the information received, up to date, shows that, although there was a considerable rise, towards the end of May, 1901, the levels, at the end of September, were only some 6 or 7 inches higher than those of the same date in 1900; also, that they were very similar to those of 1899, and were some 18 inches lower than those of the same period in 1898. It would be unadvisable to draw any conclusions from the above. The period of time, for which these records exist, is very short and but little is as yet known of the relations existing between the levels of this lake and the summer supply of the White Nile. All that can be definitely stated is, that, at the end of the year 1900, the lake levels were abnormally low, and that those of 1901, at the same period of the year, were not much higher.

I would again point out, how urgently a gauge is needed upon the Albert Nyanza Lake. This sheet of water must undoubtedly exercise a very considerable influence upon the discharge of the White Nile, and information regarding its rise and fall would be of the highest value to Egypt. A record also, of the rainfall, over its catchment basin, would be of the utmost importance.

As the Uganda Protectorate has now been under English control for some years, and as progress is evidently spreading throughout its area, it should, surely, not be altogether impossible to form a station, for registering both the levels and the annual rainfall of this lake.

The "Sudd" in the Bahr El-Gebel.

During the spring of the year 1901, I visited the "Sudd" in this river, and embodied my conclusions thereupon, in a Report. This Report, with a covering despatch by Lord Cromer, was published in the summer of the same year.* In that report I described the river, and the causes and formation of the "Sudd" at considerable length. I will not consequently repeat my observations here. It will be sufficient to say that, at the time of my visit, a length of some 23 miles of river, alone, remained blocked by weed. In the course of last year, a credit of £.E.4000 was granted by the Ministry of Finance for the completion of this necessary work, and in the following winter, Major Matthews, with a party, started from Khartoum to commence removing it. Up to the time of writing, no final report of the progress made has been received from him. Enough, however, is known to prove that he has experienced far greater difficulties than had been anticipated, owing to the absence of any current in the blocked channel, and to difficulties of obtaining fuel for his steamers. It is more than probable then, that he has had to abandon work for the current year, owing to the advent of the rainy season. In my opinion, it his highly necessary that this clearance should be effected next winter. The alternative channel, consisting of a series of wide and shallow lakes, is not a good one, and much waste of water must be caused by evaporation. Once the "Sudd," in this reach, has been removed, I see no reason why the river should not be kept permanently open, if, as at present, it is regularly patrolled by steamers. The expenditure for 1901, as far as the accounts have been received, was £E.2311,484 mill.

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* Foreign Office Blue-Book. Egypt No. 2 (1901).

IRRIGATION EXPENDITURE IN 1901.

The following tables give the particulars of the expenditure upon Irrigation works, in 1901. Omitting the sums paid to Sir John Aird and Co. for the Nile Reservoir works, the total disbursements amounted to £E.1,366,647.144 mill.

This expenditure is distributed as follows:—

TABLE I.

Ordinary Budget.

	£E.	Mill.
Central Office charges (including supplementary Reservoir expenditure	76442	594
Upper Egypt	225867	676
Lower Egypt	330651	455
Total	£E.632961	725

TABLE II.

Extraordinary Budget.

	£E.	Mill.
Drainage Works (Caisse grant)	139011	755
Irrigation Works (Caisse grant)	438544	101
Weirs below Barrage (Caisse grant)	6321	810
Zifta Weir (Caisse grant)	121059	338
Total	£E.706937	004

TABLE III.

Various Special Credits.

	£E.	Mill.
Special Works necessitated by low Nile (Caisse grant)	9622	335
Dredging Mahmudiyeh Canal (Caisse grant)	1117	818
Rosetta and Damietta Sudds (Caisse grant)	12933	339
Barrage Gardens (Finance Ministry)...	763	439
Removal of sudd in Bahr El Gebel (Finance Ministry)	2311	484
Total ...	£E.26748	415

These three tables may then be united in one, showing the total expenditure, thus:—

TABLE IV.

TOTAL EXPENDITURE.

	£E.	Mill.
Ordinary Budget	632961	725
Extraordinary Budget	706937	004
Various Special Credits	26748	415
Grand total	£E.1366647	144

The expenditure under "Ordinary Budget," as above, is distributed as follows:—

TABLE V.

	£E.	Mill.
(*a*) Regular Budget (including supplementary Reservoir Works)	204223	463
(*b*) Corvée Relief granted by Caisse de la Dette ...	249998	702
(*b'*) Corvée Relief granted by Finance Ministry ...	153508	175
(*c*) Agricultural Roads	19311	532
(*d*) Special credit for Bridges to replace Ferries ...	5919	853
Total	£E.632961	725

(*a*) The item "Regular Budget," in above, is, again, thus subdivided:—

TABLE VI.

	£E.	Mill.
(1) Establishment	72168	074
(2) Contingent charges	20374	907
(3) New Works	11233	753
(4) Maintenance and Repairs...	66198	185
(5) Khatatbeh and Atfeh Pumps	1709	330
(6) Drainage of Lake Mareotis	11000	000
(7) Land charges	2503	734
(8) Supplementary expenditure connected with the Reservoir	19035	480
Total	£E.204223	463

I will, very briefly, discuss each of these items.

(1) and (2) Establishment and Contingent Charges.

These two items are less, by £E.1744,136 mill., than the similar charges for 1900. No special remark is called for.

(3 *and* 4) *New Works and Maintenance and Repairs.*

The total expenditure under these two heads is less, than that of the year previous, by £E.10817,074. As was explained last year, this does not mean a reduction in the total amount of work done, but merely a difference in the manner in which the charges are allotted. The money is now placed in the "General Reserve" and from this, is distributed between the credits for special works, as a supplement to those granted by the Commissioners of the Public Debt Office.

(5) *Khatatbeh et Atfeh Pumps.*

1901, shows an excess of £E.1214,587, over the year 1900. The reason is that these pumping stations required important repairs. £E.970 was spent upon new works, at Atfeh pumping station alone.

(6) *The Drainage of Lake Mareotis.*

In this instance there is a heavy excess to record. The expenditure of 1901 exceeds that of 1900 by £E.3265,030 mill. This does not, however, represent the real excess, as, in addition, an extra grant, of £E.3656,837 mill., was made, in order to meet the deficit on the Mex pumps. The total excess for 1901, over 1900, was therefore £E.6921,867 mill., and the total expenditure for the years £E.14656,837 mill. This matter will be alluded to later, when the new pumps are described.

(7) *Land Charges.*

These call for no remark. There is a small excess of £E.120,611 mill., over the expenditure for 1900.

(8) *Supplementary Works connected with the Nile Reservoir.*

These charges were less in 1901, than in 1900, by £E.2298,544 mill. They represent the cost of the supervising Government Staff at Aswan and Asyut, and that of dredging the river, at the latter place.

(*b*) CORVÉE RELIEF.

Items (b and b′) in Table V call for few remarks. The distribution of these credits, as regards the Caisse money, was the same as in previous year. That of the credit furnished by the Ministry of Finance, was regulated by the necessities of the different localities in which Corvée relief was applied.

The following is a subdivision of the expenditure under this head :—

TABLE VII.

	Upper Egypt.		Lower Egypt.		Total.	
	£E.	Mill.	£E.	Mill.	£E.	Mill.
Money furnished by the Caisse ...	127999	999	121998	703	249998	702
Money furnished from Regular Budget	51363	000	102145	175	153508	175
Total	179362	999	224143	878	403506	877

The only two items of expenditure in Table V, remaining for discussion, are *(c)* Agricultural Roads, and *(d)* Bridges to replace Ferries. I will take the latter first.

(*d*) BRIDGES TO REPLACE FERRIES.

The total expenditure under the Caisse grant in 1901, was £E.5919,853 mill. For this sum, eight bridges were put in hand, three being in Upper, and five in Lower Egypt. An additional sum of £E.2277 was contributed by the State Railways, and by the villages interested.

In the Girga Province, a sum of £E.27113 has been voted, by the Provincial Council, for the construction of 49 bridges. The Council decided to levy a special rate upon the cultivated land, in order to raise the money.

The expenditure, in 1901, was £E.7309,196 mill., for which sum, 14 bridges, consisting of timber platforms upon masonry abutments and piers, were constructed.

As a proof of the way in which the people appreciate improved communications, it may be mentioned that the Province of Kena, has recently followed the example set by Girga. The Local Council has voted a considerable sum of money, to be applied to a similar purpose, in 1902.

(c) AGRICULTURAL ROADS.

The following are the figures for 1901 :—

LOCALITY.	Length of roads existing previous to 1901.	Length of roads constructed in 1901.	Expenditure.	
	Kilometres.	Kilometres.	£E.	Mill.
Upper Egypt and the Fayum...	616	15	1443	662
Lower Egypt...	1765	17	17868	155
Total... ...	2381	32	19311	532

The progress, in 1901, was very small. In Upper Egypt, this was largely due to the fact that many new drains and canals are in course of construction, in connection with the Reservoir remodelling. It was thought best to defer the construction of the new roads until these works were completed. In Lower Egypt, the development of the road system has been suspended, until some means of raising the requisite funds for maintenance can be found.

The very heavy expenditure shown, in proportion to the length of road constructed is due to payments made in 1901, for work done, and land bought, in 1900. The total length of agricultural road, now existing in Egypt, is 2413 kilometres.

The maintenance charges were:

	£E
In Upper Egypt...	2064
In Lower Egypt...	3161
Total	£E.5225 or average or £.E.2·12 per kilometre.

This expenditure is quite inadequate to keep these roads in thorough annual repair. As was stated in last year's report, the Local Councils have refused to find the funds for the maintenance of these lines of communication. The money cannot be found, for the present, from the Public Works Budget, as all available funds are necessarily devoted to the maintenance of the canals and drains. For a time, therefore, any further road extension is impossible.

EXTRAORDINARY BUDGET.

Tables II and III, refer to the works constructed under various special credits, the expenditure for which is classified as "Extraordinary," as distinguished from the "Ordinary" or regular charges.

I will discuss the different items, in the order in which they come in these Tables, commencing with Table II. As was the case last year, the expenditure on the items of Drainage and Irrigation works, has been derived from two sources, viz., from the "ordinary," as well as from the "extraordinary" budget. Both the above, are in this instance, classed as special credits. I will not, therefore, in discussing them, attempt to separate the two charges.

DRAINAGE WORKS IN 1901.

The total expenditure in 1901, not including maintenance, was as follows:—

	£E.	Mill.
Upper Egypt..	22369	000
Lower Egypt..	136920	000
Total...	£E159289	000

If to this be added, the amounts spent upon pumping in the shape of drainage, which equalled £E.23486 in 1901, the total expenditure for the year equals £E.182775.

For this sum, 485 kilometres of drain were constructed and remodelled.

This expenditure includes all the necessary masonry works in connection with the new channels.

The principal drainage systems remodelled, in 1901, were the following:—

UPPER EGYPT.

(1) The West Muhit system. This is a project for diverting a portion of the drainage of the perennially irrigated lands into the Bahr Yusuf, downstream of the Mazurah regulator.

(2) The Tagin drainage system, in the Province of Fayum.

(3) The Etsa pumps. These are to take the drainage of the Sefi lands and discharge it into the river during flood.

All these works are well advanced, and should be completed in 1902.

LOWER EGYPT.

(4) In the systems of Bahr El-Bagar, El-Arin, Saft, Hadus and Siru, the remodelling was continued, and the branch drains perfected. All these drainage lines lie in the Provinces of Sharkia and Dakahlia.

The construction of the above involved many masonry and timber works in the shape of bridges, syphons, acqueducts, etc.

(5) For the Province of Garbiyeh, the following systems were in progress in 1901.

The Bahr Shibin, the Sharkawiyeh, the Bahr Mallah, the Ariamum and the Nashart.

All of these are extensive drainage systems affecting a very large area. Each comprises a large number of branch drains.

(6) In the Province of Behera, the systems of Edku and Mareotis drains were proceeded with.

The expenditure of 1901, brings the total sum, spent upon drainage works, since 1885, to £E.1468187, and the total length of existing channel, to 4185 kilometres. The greater portion of these channels are in Lower Egypt, but good progress has been made in the Fayum. With the transformation of the Middle Egypt basin-areas, an elaborate drainage system will be involved, which will add still further to the length of channel to be maintained. As I said in my last yea,r Report, a few more years, at the present rate of expenditure, should see the main drainage, of the existing cultivated area of Lower Egypt, completed. With time; and with an increased water supply, new tracts of land will be brought into cultivation, each of which will require its drainage system, as well as its canal system. Still, the heaviest portion of the expenditure has been accomplished, and after two or three more years, it should be possible to go slowly, and to reduce drainage expenditure to a moderate figure.

Of the benefits resulting from the construction of these drains, it is not necessary to speak. They are known and appreciated by every landowner in Egypt.

Pumping Stations for Drainage in Lower Egypt.

These are that, of Kassassin, in the Sharkia Province, and of Mex, in the Behera Province.

The Kassassin pumps drain the Wadi Tumilat, which tract will be alluded to later on. It is sufficient here to state, that, the expenditure in pumping for last year came to £E.3961, or some £E.700 more than in 1900.

The high rate of coal is stated to be the reason for this increase, but the Inspector, in charge of this station, thinks that a maximum cost, for pumping, has been reached.

The height to which the water had to be lifted, in 1901, was increased by the bad state of the out-fall drain. This is being remedied, as the drain is being dredged.

The Mex Pumps.

This is a most important station, containing seven, powerful centrifugal pumps, which, when working full-power, are competent to lift some 3,000,000 metres cube of water, in 24 hours. In the winter of 1900-1901 they actually were obliged to work full-power for a period of 37 days. In spite of this, it was found impossible to keep the water level of Lake Mareotis down. It rose steadily, owing chiefly to the heavy rainfall of the winter in question, and it seems not improbable that the number of pumps here, will, one day, have to be added to.

The largest amount of water actually lifted, in any one day, was 3,425,862 metres cube, while the total for the winter, i.e., from the 29th October 1900, to the 17th April 1901, equalled 316,693,553 metres cube of water. This is the heaviest cube yet reached, and the expenditure was heavy in proportion, being £E.14651, or a rate, per million cubic metres of water lifted, equal to nearly £E.45. Here, as at Kassassin, the high rate of coal has considerably increased the cost of pumping. The mean height to which the water was lifted was 3·02 metres, and the quantity of coal used was 5993 tons.

Major Brown gives a table of comparison showing the amount of water raised since 1895. The continual improvements in the Behera Province drainage system, have thrown an immense amount of extra work upon these pumps, which drain considerably more than half of the Behera Province.

The cost of pumping at Mex is a very heavy annual charge upon the Irrigation Budget, and as the maintenance charges, consequent upon the large number of new channels annually constructed, are rapidly increasing also, it is certain that, before many years are over, an increase will have to be made to the Budget allotment.

I pointed out in previous Reports, how largely the lands, affected by these pumps, have increased in value, and how easily and how gladly (at first), the landowners would have paid a small tax per feddan of land benefitted by this drainage. Such a tax is levied in other countries under similar conditions, notably, in Holland and in Italy. To my mind, it would be advisable to impose such a rate in Behera. It is true that Egyptian landowners in other localities, do not have to pay any tax of the kind, but, on the other hand, the Government is not called upon, in such localities, to meet the heavy annual cost of pumping. Again, owing to their vicinity to Alexandria, the Behera lands are very favourably circumstanced and can command an average higher rental-value than is the case in other Provinces.

Another difficulty, which the Irrigation Service has to meet in connection with Lake Mareotis, is the sum which it has annually to pay for compensation for the low-lying lands bordering the Lake, which are swamped whenever the water level rises, from rain, or other causes, by a few centimetres. The Mixed Court in Alexandria decided in a case, tried not long ago, that the Government was responsible for any such damage caused, and set aside the pleas raised by the Government Engineers, that this flooding was largely due to natural causes, such as rainfall, and that, moreover, the proprietors took no steps whatever to protect their lands. Judgment having been thus given against the Government, there is nothing more to be said. We have, consequently, felt obliged to give up contesting any similar claims and to pay them annually. It will be, decidedly, in the interest of Government to expropriate and purchase all low-lying lands in the vicinity of this Lake, and thus dispense with the necessity of having to compensate proprietors who take no protective measures for their lands. Plans are now being prepared, with a view to studying this question. A further advantage will be that pumping may, in future, be reduced, as a considerable sum is now yearly expended in trying to lower the water, so as not to flood these particular lands. Once these become the property of the Government, the water may be allowed to rise over them. The State will lose very little by this, as the taxes imposed upon them are extremely low, although the rental-value obtained is high.

MAIN IRRIGATION IMPROVEMENTS IN 1901.

The credit, for the year, was:—

	£E.	Mill.
For Upper Egypt	356565	000
For Lower Egypt	272500	000
Total...	£E.629065	000

Of the above, £E.71346, was supplied from the Regular Budget and the balance viz., £E.557719, granted by the Public Debt Commission.

In the above expenditure, that incurred upon the new weir at Zifta is included, as is also the completion of the weir downstream of the Barrage.

The following is a brief description of the more important works upon which expenditure was incurred in 1901 :—

UPPER EGYPT.

Remodelling of the Basins west of the Yusifi Canal.

This work, which was commenced in 1899, and was estimated to cost £E.200,000, has been described in previous reports. The object aimed at was to give these tracts their fair share of the flood water, at the time when it is rich in fertilising matter. Previous to these remodelling works, this was impossible. They have now been practically completed, at a cost of £E.190981, of which £E.34642,348 was expended last year.

Two large regulators and locks have been built in the Yusifi Canal itself. The area benefitted is some 70000 feddans, which is now equal to the best basin-land in Upper Egypt.

Mazurah Regulator and Lock, on the Bahr Yusifi.

This work, which was described last year, was completed in 1901. The total cost has been £E.53381, of which £E.31897 was spent in 1901. Its object is to improve the irrigation of 33000 feddans of land ; to improve the drainage of the Minieh Province, and to supplement the flood-supply of the future perennial canals, in the province of Beni Suef.

The Walidyeh Syphon.

This has been constructed to ensure the irrigation of the Walidyieh Basin lying to the west of the Ibrahimyeh Canal. This basin, which is fed directly from the river, has invariably suffered in years of low flood. In future it will be connected with the central basin of the well-controlled Sohagiyeh system. It is estimated to cost £E.4500. A commencement was made last year, and £E.1500 was spent. It will be completed in 1902.

Remodelling Works in the Fayoum Province.

The principal irrigation improvements in this Province were the following :—

(*a*) The Hassan Wasif Canal

(*b*) The Bahr Nezleh and its branches
(*c*) The Metartaris-Alan Canal project
(*d*) The Bahr Seilah.

The Hassan Wasif Canal.

This work was completed during 1901. It is practically a new canal, although a portion of it follows an old alignment. It was made use of during last year's flood and will serve an area of 106000 feddans. The total cost has been £E.61865, of which £E.57210 was spent in 1901; the balance, which is due for land taken up, remaining to be paid in 1902.

The Bahr Nazlah.

Good progress was made with this very important remodelling project, and £E.30985 was expended last year. As the excavation involves much rock-cutting, the work is a costly one, but it will benefit a large tract of country.

The Metartaris-Alam Project.

This was completed in 1901 at a total cost of £E.4886. It consists of the suppression of the old canal, of that name, to feed which, water had to be held up (to a very high level) in the Bahr Junkalla, and the transfer of the irrigation to the Alam and Ewald systems.

Bahr Seilah.

In this project, a new canal, the Abdul Wahby, is to be constructed which will feed a large area of land, at present un-irrigated and untaxed. In order to do this, the Bahr Seilah has to be widened. A commencement was made in 1901, and £E.2200 expended.

THE HAMAD ESCAPE (KENA PROVINCE.)

The old work failed after the flood of 1900, owing to the carelessness of the Engineer in charge.

It has been replaced by a new escape, consisting of six openings, of 3·0 metres span each. It was completed before the flood of 1901, at a cost of £E.15470,177 mill.

THE TALIHAT REGULATOR ON THE SOHAGIYEH CANAL.

This is a very large and important work, consisting of twenty openings each 3·0 metres in width. The foundation and floor were completed in 1901, at a cost of £E.12000.

CONVERSION OF THE ASYUT BASINS.

This is the first of the works actually connected with the Nile Reservoir, and Mr. Verschoyle gives a long and very interesting note, respecting it. In all, 58085 feddans of basin have been transformed and are now ready for "Sefi" irrigation. This has involved the construction of 250 kilometres of new canal, and 127 kilometres of new drain. The total cost (including land) has been £E.109577,933 mill. Of this, £E.87060, was expended in 1901. To entirely complete the programme for this province, some further expenditure will be necessary in 1902. This will bring the total cost up to £E.135032, which means an average, per feddan transformed, of £E.2.33. On the 10th of August, 1901, water was admitted into these canals, and 17024 feddans of Dhurra were, thereby, raised. The gross value of this crop was £E.102144. This means, after deducting cost of cultivation, a net profit to the landowners, of £E.85120. The entire area was afterwards put under winter crops. The above will give some idea of the increased return due to the change, in one season, and it must be remembered, that summer water, by which the more valuable crops are raised, has *not yet been given.*

Mr. Verschoyle quotes Mr. Hopkins, one of the Inspectors of the Finance Ministry, to the effect, that the value of the land, over the whole area converted, has increased, on an average, by £E.15 the feddan. Also, that in some instances, contracts have been made for letting the land, showing a remarkable increase in the rental-value. Thus, in certain places, this has increased from 275 P.E., to 500 P.E. the feddan, and in others, from 300 P.E., to 600 P.E. the feddan. When the new tax, of 50 P.E. per feddan, is eventually imposed upon this area, it will bring in a return of over £E.29000 per annum. This represents to the Government, nearly 20 per cent interest on the capital expended in the actual transformation works. Of course, in the above, no account has been taken of the expenditure involved by the construction of the Reservoir. The figures are merely given to show that, with sufficient water, it is a profitable undertaking for the Government, as well as for the landowners, to give perennial-irrigation to the basin tracts.

THE IBRAHIMIYA CANAL REMODELLING.

The conversion of the Middle Egypt basins has involved very heavy work, in the enlargement of this canal, which was not of sufficient section to take in the required extra summer discharge. In 1901, a cube of some 4½ millions of metres of earthwork was executed, and a regulator built, at a total cost of £E.28071,682 mill.

IMPROVEMENTS IN THE BAHR YUSIFI.

An exaggerated loop in this canal was cut off, at a cost of £E.10831,016 mill. Whereas, the canal, formerly, by following this loop, had a length of 1600 metres; by the new straight cut, it arrives at the same point, in a length of only 500 metres.

CONVERSION OF THE MINIA BASINS.

A commencement was made with this work in 1901, and a sum of £E.15322,312 mill. was spent. It is hoped that, in 1902, the remodelling of this Province may be well advanced towards completion.

LOWER EGYPT.

The following were the more important works, undertaken in 1901.

A NEW REGULATOR AND LOCK FOR THE ISMAILIA CANAL.

This work failed many years ago, owing to badly designed foundations and to the exceptionally treacherous nature of the subsoil. More than one attempt was made to repair it, but none met with success. It was eventually decided to abandon the old work and to construct an entirely new one. In consequence of the difficulties connected with the soil, well-foundations were decided upon. During 1901, the whole of these brick-wells were sunk to the required depth, and, in this respect, good progress was made. This, however, is all the praise that can be given. The officer directly in charge of this work, allowed it to be carried on, long after the rise of the flood (under the direction of a subordinate who would appear to have possessed insufficient experiene), and under the most unfavourable conditions possible. The consequence was, that the wells were badly filled, and, in some instances, badly sunk. The result has been, that increased expenditure has been necessitated in 1902, in repairing the faults of the previous year.

The work, when completed, is estimated to cost £E.61368, of which £E.29269, was spent in 1901.

Siriakos and Bilbeis Regulators.

In addition to the head-works just described, alterations are necessary to the above works, both of which are situated on the Ismailia canal. In both instances, an additional water-way is required. These also are to be founded upon brick wells. A commencement was made at Siriakos in 1901, and a sum of £E.3346 was expended.

Dimera Regulator and Lock.

This regulator is to be remodelled, and a new lock built. The total estimate for the work is £E.68[illegible]1. A sum of £E.1900 was expended on materials last year, and it is expected that the work will be finished in 1902.

New Works on the Rayyah Behera.

The old head of this canal at the Barrage, has proved insufficient and requires enlargement. This involves the construction of two new spans and of a new lock. The whole structure will be fitted with gates, similar in pattern to those in use at the Barrage.

A commencement was made in 1900, when £E.5029 was spent upon collection of materials. In 1901, good progress was made with the work, which was carried out under exceptionally difficult conditions. Major Brown gives a detailed account of this work, in his attached report. It is hoped that the new structure may be completed in 1902, but this is not yet quite certain. Last year's expenditure amounted to £E.20643 and the total estimate is for £E.38735. When this work is finished, the last of the remodelling works, in connection with the Barrage, will have been completed.

The Nikla Regulator, on the Rayyah Behera.

This is a large work of five openings, each 8 metres wide, with a lock 35 metres long by 8 metres wide. Its object is to give control ower the water at the time of discharging the basin of this name.

This operation has, hitherto, been one of considerable difficulty and even of danger. The discharge, at present, takes place into, and across, the Rayyah Behera, on a level crossing. Once the regulator is completed, the difficulties of discharging this water will disappear. This work was practically finished in 1901, the lock gates only remaining to be hung, in 1902. The total estimate amounts to £E.26452, of which £E.17123 was expended in 1901.

THE KHATATBA FLOOD FEEDER.

This important work was completed in 1901, at a cost of £E.15699. When the flood, in the Rosetta Branch of the Nile, reaches a certain height, the water-supply, for the Province of Behera, is taken in by this channel, and the head of the Rayyah Behera is closed. This procedure is adopted with a view to reducing silt deposit in the canal in question. Previous to the construction of the present work, the feeder channel was closed by an earthen " Sudd, " which was annually cut on the arrival of the flood water.

MAHMUDIYEH CANAL BRIDGES.

Three bridges upon this canal, lying within the limits of the town of Alexandria, have fallen out of repair. One of these was repaired in 1901, at a cost of £E.3250.

GIZA PROVINCE.

The remodelling works were briefly described in last year's report. They are, all of them, for the purpose of improving the flood irrigation of the Province, but at the same time, each work is designed with a view to its utilisation, when perennial irrigation shall eventually be given to this Province.

A sum of £E.15949 was spent in 1901.

TRANSFORMING THE SISA, MARSAFAWIA AND GALAGIL CANALS FROM "NILI" TO " SEFI."

These three canals are situated in the Kaliubia Province, and the work of transformation is being undertaken, with a view to giving them " Sefi " water, upon the completion of the Nile Reservoir.

£E.3315 was spent last year.

WIDENING KODABA CANAL.

This work is that of improving navigation in one of the most important canals of Garbieh. £E.5376 was the cost of the widening, completed in 1901.

WIDENING THE SAHEL MARKAZ CANAL IN BEHERA.

This work has been described in several previous reports. It is hoped that it will be completed next year. The sum expended in 1901, was £E.10227.

REMODELLING MAHMUDIYEH CANAL.

This is a long and difficult task. It consists in remodelling the banks of the canal, and bringing them to the required uniform section; also, in demarcating the boundaries of the Government land, occupied by this canal. £E.1199 was spent, last year, upon this work. It is likely to take several years to complete.

THE ZIFTA BARRAGE.

This, next to the Nile Reservoir works, was the most important project under construction, in 1901. It originally formed a portion of the Nile Reservoir project, but was temporarily laid aside. In 1900, it was decided that this work was an indispensable one, and it was again studied. The whole design was re-cast, and one almost exactly similar to that of the Asyut Weir, was finally adopted. The main difference between the two works is that, at Asyut, stone has been used, while, at Zifta, brick masonry has been substituted.

The point selected for this weir, is a few miles north of the town of Zifta, on the Damietta Branch of the Nile. This point is rather less than half-way between the Delta Barrage and the Sea. The main object of the work will be, to directly supply the main canals which irrigate the northern tracts of the Deltaic provinces, instead of as at present, feeding them from above the Delta Barrage. The canal system will thus be divided into two lengths; the southern being fed from above the existing Barrage, and the northern taking its water from above the new Zifta Weir. This work, therefore will provide a new and important point of supply from the river. It will also intercept the discharge of the Damietta Branch, due to springs and infiltration from adjoining lands, over a considerable portion of its length, and make this discharge available for irrigation.

It is not difficult to comprehend the advantages which will result from the completion of this work.

The canal systems which start at the Delta Barrage are very long, and traverse large areas of country. It is consequently, even with the most perfect system of rotations, difficult, in summer, to pass the water down to their northern reaches in sufficient quantity to give the lands dependent upon them their fair share of water. The Zifta weir will practically halve these long canals, and will, consequently, greatly facilitate the equitable distribution of the water.

The Zifta Weir was commenced in 1901; the amount of the estimate being £E.480000 (including subsidiary works). This includes a lock for navigation. The total length, including the lock, is 378 metres, from bank to bank. It is designed to hold up 4·0 metres of water.

There are 50 bays, of 5·0 metres opening, each, with abutment piers between each group of ten openings.

It has already been stated that the design is practically identical with that of the weir at Asyut. The main difference is that, whereas in Asyut, the cast-iron piles which confine the whole foundation up and downstream are of the same length; at Zifta, the downstream piles are shorter, by 6·0 metres, than those on the upstream line. The lock is 65 metres long, by 12 metres wide.

The credit asked for the 1901, was only £E.86000. This was for purchase of materials alone. Major Brown, however, found that the foundations were likely to be better than was anticipated, and applied for sanction to make a commencement of the work itself.

A further credit was then applied for. There had been a large economy on the estimate for the weirs downstream of the Barrage, amounting to some £E.96000. The Caisse was consequently asked to permit of £E.44000, of this economy, being used in 1901, upon the Zifta weir. Permission was given and work was so vigorously pushed forward that, by the end of July, the foundations not only of the lock, but of a length of 71 metres of the weir proper, were completed. The superstructure was also well advanced before the arrival of the flood; the lock walls and sills being raised to a height of 5 metres above bed, and the piers to 1·60 metres above the flood-level. The credit granted for 1901, was £E.130000, and the expenditure £E.121059. Progress in 1902 has been so rapid that there is every probability that the work will be entirely completed by the end of the current year.

This satisfactory result is very largely due to the excellent arrangements made by Major Brown, who has given the work muck personal supervision. Great credit must, however, be also given to Mr. F. Hurley, the Resident Engineer.

Mr. Hurley has directed the construction of this large work in a most satisfactory manner. He has shown a considerable talent for organising and controlling labour.

THE WEIRS DOWNSTREAM OF THE DELTA BARRAGE.

These works were practically completed in 1900, and very little remained to be done in 1901.

Last year's work, chiefly consisted in raising the crests of the weir to their full height, and in laying the ashlar slabs which form them. It was completed by the 16th of May.

The total expenditure, in 1901, was £E.8322, but a sum of £E.2235 was reserved, upon the estimate, for expenditure in 1902, in the construction of lock-keepers' huts, etc., and in generally clearing up and levelling off the sites.

A considerable economy has been realised upon the estimate. This amounted to £E.530000, whereas the expenditure was only £E.434000, leaving a saving of £E.96000.

Of this £E.44000 was transferred to the Zifta Weir works, as has been related, and the balance, viz., £E.52000, was declared, in November 1901, to the Commission of the Public Debt, as available for employment upon other works.

It is probable that the economy would have been still larger, had it not been that the price of Portland cement, during the period of construction, was abnormally high. Each barrel purchased cost 60 P.E., whereas the present price is only 45 P.E. per barrel. As cement to the value of £E.100000, was purchased, it is evident that this high rate caused a serious increase in the cost of the work.

These weirs have now been tested for a whole season, and have proved to be thoroughly sound and efficient. The "afflux," even at mean flood, has been scarcely perceptible. The important part which these weirs have played in last season's irrigation, has been already alluded to, in that part of this note which relates to the river supply. I will only repeat here, my former remark, viz., that it is not too much to say that they saved the cotton crop of Lower Egypt.

Major Brown may well feel a pride in the successful results of his three years' hard work in connection with these weirs.

WORKS CARRIED OUT FROM VARIOUS SPECIAL CREDITS—VIDE TABLE III.

The works in Table III, which come under the head of "Irrigation," are the following :—

	£E.	Mill.
Special Low Nile credit...	9022	335
Dredging Mahmudiyeh Canal.	1117	818
Rosetta and Damietta Sudds..	12933	339
Maintenance of Barrage Gardens..	763	439
Cutting the "Sudd" in the White Nile	2186	677
Total	£E.26623	608

Special Credits for Low Nile.

The principal item under this head, was the cost of working the Afteh Pumps, and the special measures undertaken to reduce "Sharaki" in Upper Egypt.

The Afteh pumps worked for 36 days, in the months of June and July. They raised 40,670,933 metres cube of water, at a cost of £E.2155, and with a mean lift of 1·83 metres.

In addition, 1,078 tons of coal were purchased, at a cost of £E.1843, as a reserve. This is now on stock. Lastly, £E.970 was expended in the purchase of two new boilers.

In Upper Egypt, a sum, of £E.4000, was expended in the construction of banks and "Hoshas," round the sahels and ghezirehs, on which "Sharaki" was feared.

The Rosetta and Damietta "Sudds."

These have already been described, when discussing the river supply.

Maintenance of the Barrage Gardens.

The item shown under this head, represents the revenue obtained by the sale of fruit, etc. This sum is utilised for maintenance by the permission of the Finance Ministry.

The "Sudd" in the White Nile.

This has been already alluded to.

WORKS UNDER ORDINARY BUDGET.

The Barrage.

The total expenditure, under the Budget allotment, for 1901, was £E.16515.

This may be thus distributed :—

	£E.
River training	2080
Staff	3490
General maintenance	5430
Gardens	952

New Works.

Nili canal head	983
Asphalt paving	1319
Engine and boilers	240
Model room	2020
Total	£E.16515

The above items may be very briefly described. The river training works are those undertaken with a view to bringing the river directly on to the two Barrages. Considerable progress has been made in this direction, but this work must necessarily be slow and will take several years yet to complete.

The Staff charges call for no special remarks. "General maintenance" includes, workshops charges, masonry repairs, painting ironwork and dredging, etc.

Gardens.—The total expenditure was £E.1664, of which £E.764 was met by sale of fruit, as has been already explained. This left a deficit of £E.952.

The New Works, call for little remark. The asphalt paving is to replace the old wooden pavement on the roadway, which was not suitable to the changes of temperature.

The model room is to contain the many models of the irrigation works which exist in this Department. As these are of considerable value, it has been thought advisable to collect them in one place, where they can be looked after and easily seen and studied.

As all new works in connection with the Barrage will be shortly completed, a considerable saving in the annual allotment should very soon be realisable. Major Brown discusses this, and estimates the possible reduction at £E.2000 per annum. Making use of his own figures for last year, it surely ought to be more than the above. Eliminating new works, these figures are :

	£E.
River training	2080
Gardens maintenance	952
Staff	3490
Maintenance	3430
Total	£E.11952

This represents an economy upon last year's budget grant equal to £E.4563. It is true that he estimates the maintenance of the new weirs at £E.1000 per annum, but it seems possible that the maintenance charges for the Barrage itself can be reduced below their present figure.

Masonry Works, New and Repaired.

These are works, not coming under the special grants.

The following is the detail of the expenditure :—

LOCALITY.	No. of Works.	Expenditure	
		£E.	Mill.
Upper Egypt	68	16636	570
Lower Egypt	48	15129	000
Totals	116	31765	570

None of these works were large, but all of them were undertaken with a view to improving the distribution of water.

Earthwork executed in 1901.

The following are the dredging totals:—

LOCALITY.	Metres cube.	Cost.
		£E.
Upper Egypt	459536	16000
Lower Egypt	1645116	57590
Totals	2104652	73590

The total cubes are rather less than those of last year. Upper Egypt shows a larger figure, in consequence of an increase in the dredging of the Ibrahimieh Canal, and in the river at Asyut. Lower Egypt, on the other hand, shows a decided decrease, thanks to the large reduction, due to spurs, in the cubes of the Rayyah Menufiyeh. The cube of of earthwork, executed by hand labour, was as follows:—

LOCALITY.	Metres cube	Cost.	
		£E.	Mill.
Upper Egypt	10052039	129959	286
Lower Egypt	12976140	236078	000
Totals	23028179	366037	286

These figures call for no special remarks.

River and Canal Protective Works.

The following is the expenditure for 1901:—

	£E.
Upper Egypt	3664
Lower Egypt	32352
Totals	£E.36016

The expenditure, in Lower Egypt, includes planting grass on the slopes of the main canals, and repairs to the seawall at Abukir.

Basin Bank Protection.

42,924 metres of banks were revetted with stone, at a cost of £E.16636,094 mill.

The total length of basins, now protected, amounts to 307,155 metres, or some 307 kilometres.

THE NILE CORVEE IN 1901.

The following are the figures, adopting, as in previous reports, the unit of 100 days.

Upper Egypt	8,561	men per 100 days
Lower Egypt	161	„ „ „
Total	8,722	men per 100 days

Except during the very low flood season of 1899, this total is the lowest yet reached.

With reference to the above, I cannot do better than reproduce here the remarks which I made on this subject to Lord Cromer, which he has quoted in his Report for 1901.*

A remarkable fact is that, in 1901, no Corvée at all was called out to guard the Nile Banks in Lower Egypt, north of Cairo. The 161 men shown above were all employed in the basins of the Province of Giza. This gives great hope for the future, as, although the flood of last year was a low one, it was by no means the lowest on record and never before in the history of Egypt has a flood season passed, however low, without the Corvée of the Northern Provinces having been called out. The figures for Upper Egypt still remain high, this being chiefly due to the extent of the basin banks in that region. At the same time, there ought to be a regular reduction in their numbers, which is not yet observable. Thus in the year 1899, the total for Upper Egypt was only 6596. It is true that this was a year of very low flood, but those of 1900 and 1901 were very little higher and were certainly not in any way dangerous floods. The figures for these years were 11775 and 8561, respectively, and these were assuredly higher than should have been the case. In this respect, the Irrigation Inspectors of Upper Egypt would seem to cling too closely to precedent, and to be too conservative. The Girga Directorate and the 5th Circle are responsible for by far the largest numbers. As these two irrigation charges are under the superintendence of Egyptian Inspectors, it would almost seem as if they were unable to shake off the old tradition of Egypt, viz., that immense numbers of men are indispensable to the safety of the banks. This may be true in a year of dangerous flood, but certainly not in one of poor levels like that of 1901.

It is only fair to Upper Egypt to state that the long length of new channels and drains, account for a good deal of the labour employed during the flood.

In Lower Egypt, kilometre posts have been set up along the Nile Banks, and registers of all dangerous points have been prepared.

The Irrigation Service is at present studying the best means for abolishing the Nile Corvée, or at all events, for reducing it to a very large extent. Proposals will be submitted for this purpose, but it is certain, that any changes had best be introduced very gradually.

The Wadi Tumilat.

Progress, in connection with the reclamation of this tract, continues to be very satisfactory.

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* Foreign Office Blue Book, Egypt No. 4 (1901).

The capital account of expenditure stands as follows:—

	£E.	Mill.
Original Estimate...	62	189
Spent in 1901...	9	481
Spent to end of 1901	35	109

The main items of expenditure were the enlargement of the main drain (which is now complete), the suppression of 17 kilometres of the old Wadi Canal, and the replacement of its irrigation by new channels taking off the Ismailia Canal.

A new boiler for the pumps and a dredger for the main drain, have been ordered.

The revenue account for 1901, stands as follows:—

	£E.
Receipts.	21132
Expenditure.	20409
Surplus	723

The chief item in the receipts, is the rent of 12,327 feddans of land, which has produced £E.20115. This rent can not be classed as a high one.

In the expenditure, the chief item is, as usual, the annual payment of £E.8000, to the Ministry of Public Instruction.

Land tax = £E.5827, Staff = £E.2043 and pumping = £E.3967. This last item was largely affected by the high price of coal.

The following shows a comparison between the original forecast and the actual results:—

FORECAST.	AS ESTIMATED		Actual surplus.
	Surplus.	Deficit.	
	£E.	£E.	£E.
1st year..	—	3640	198
2nd year..	—	2150	314
3rd year..	350	—	720
Total...	350	5790	1232

In place then of a net deficit of £E.5440, as was estimated, the actual result has given a surplus, on the first three years, of £E.1232.

This is highly satisfactory, and reflects great credit upon Mr. Langley and Musa Bey Ghaleb, who control the reclamation of this area.

Out of this surplus, £E.1117 has been expended in the purchase of 63½ feddans of scattered plots of land, which it was undesirable that outsiders should possess. This leaves the net balance = £E.115.

The following shows the areas leased :—

Years.	Forecast.	Actually leased.
1899	8,000	7,578 feddans.
1900	9,000	8,382 "
1901	10,000	12,332 "

It may be mentioned that the original forecast for 1902 was 11,000 feddans, while the latest estimate is, that 14,040 feddans will be leased in that year.

The crops raised were good, with the exception of the cotton crop, which suffered from fogs. At the late agricultural show, this estate had eight exhibits and seven awards, including one first prize for mats, and a bronze medal for cotton.

Flour mills, worked by water, have been erected and have, already, proved remunerative.

THE NILE RESERVOIRS.

Mr. Webb, in his attached Report, has given an excellent account of the history of these works and of the yearly progress made since their commencement. I will therefore confine my present remarks to a brief description of last year's work.

The Aswan Dam.

By the end of the year 1900, construction had been so energetically proceeded with that, the only foundation work remaining to be executed was that of the large channel on the extreme west of the dam.

On the 21st November, 1900, as soon as the flood had subsided, the work of closing this branch of the river was commenced, by throwing a stone dam across what is known as the Mohamed Ali channel. This done, "Sudds," of stone and of sand-bags, were carried across the western channel, upstream and downstream of the line of the dam. By the 1st week of February, 1901, these were closed, and, by the 21st of that month, the foundation pit was pumped dry. Four 12″ centrifugal pumps were employed in unwatering the area enclosed by the "sudds," but eventually one pump was found to be sufficient to keep down the leakage through these temporary dams.

It was hoped that the rock, in the bed of the western channel of the river, would prove to be sounder than had been the case elsewhere. Unfortunately, this hope was not realised. The rock, here, proved to be as badly decomposed as in the worst points along the foundation trench, and excavation had to be carried down to an average depth of 6 metres below the river bed, before solid rock was reached, while for a length of some 80 metres, the depth was as much as 7 metres.

By the 17th April, the excavation was completed, and the masonry of the foundations was commenced. By the 17th of July, it was raised, throughout, to R.L. 96, or 21 metres above the bottom of the lowest point of the foundations of the dam.

Throughout the rest of the structure, the masonry was so energetically pushed forward that, by the arrival of the flood, the only lengths of dam submerged were in the western channel above-mentioned and in a part of the central channel. These portions were purposely left low, in order to permit of the passage of a possible high flood and in order to prevent the inundation of buildings and lines of railway required for the following season's work.

By the end of 1901, the masonry, throughout the line of the dam proper, was brought up to an average of R.L. 99, i.e., only 10 metres below the eventual crest-level of the structure. On the lock, also, excellent progress was made, so much so that, by the end of last year, only 6,000 metres cube of masonry remained for execution in 1902.

Considerable improvements were carried out in the river, up and downstream of the navigation channel, with a view to rendering the passage of steamers and boats easier. In all, 25600 metres cube of rock were removed for this purpose in 1901.

In order to give a free water-way to the sluices of the dam, a trench, 5 metres wide, was excavated along the upstream face of the work, wherever the rock was higher than the cills of the sluices. On the downstream face also, considerable excavation was carried out, so as to improve the free discharge of the sluices, by assisting the escape of the water.

60000 metres cube of rock were blasted and removed, in this particular work.

The total cubes executed are as follows:

NATURE OF WORK.	Executed in 1901.	Executed to end of 1901.
	Metres cube.	Metres cube.
Rock excavation	112855	690370
Masonry	236344	475812

By the end of last year, only 65000 metres cube of masonry remained for execution, and it is confidently expected that the whole will be completed by the end of May, 1902.

The progress made with the ironwork was also eminently satisfactory. All the undersluices, in which cast-iron linings were decided upon, were erected. The cast-iron grooves and cills of 100 sluices were fixed, leaving only 80 sluices to be thus provided for in 1902.

A commencement was made with the sluice-gates, and 30 of these were in position by the end of last year.

In the lock, the erection of two of the large gates was commenced.

The total value of "permanent" work completed up to the end of 1901, was £E.1821617.

By the terms of the contract, the contractor receives payment in advance, upon "preliminary" works in general, and also upon materials, plant and ironwork. These advances are recovered from the payments made upon "permanent" work done. A retention is also made upon the work while in progress.

	£E.
Thus, the value of "permanent" work being as above shown, viz.	1821617
The retention equals	33000
Difference =	£E.1788617
The total payments made to the contractor, up to the end of 1901, equals	2108972

The account then stands thus :—

Value of permanent work (less reduction)	1788617
Advances on preliminary work, materials, plant, etc. ...	290555
Payments made for land	29800
Total...	£E.2108972

As regards the above, the advances, i.e. £E.290555, will all be recovered from the payments made for "permanent" work during 1902.

The average number of men employed, at Aswan, in 1901, was 5,347, of whom 756 were Europeans.

The greatest number employed in any month, was in June last, when 8,552 natives and 902 Europeans were at work.

Arrangements were made, in 1901, to demarcate the water-levels, which affect the villages and lands which will be inundated when the Reservoir is full.

A series of monthly river discharges has been commenced at Wadi Halfa and at Aswan, in order to assist in the calculation of the amount of water available yearly, for storage in the Reservoirs.

The Asyut Weir.

At the beginning of last year, the only foundation work remaining for execution was a short length in the middle of the river. Although this length was short, the work was of an exceptionally difficult nature, owing to being situated in the very centre of the main stream. It moreover necessitated very long and costly "Sudds," as it was found impossible to enclose it, except by carrying out these "Sudds" from the east bank.

This necessitated the un-watering of a very large area. In fact, the "Sudded" enclosure was 13¼ acres in extent. The "Sudds" were commenced on the 28th of January, and, by the 4th of May, pumping was commenced.

Fifteen 12″, one 10″, one 8″, and one 6″ pump were employed on this work. By the 10th of May, a start was made with the foundations.

On June the 12th, the last stone in the foundations was laid, and by the 30th of that month all the piers were raised above mean water-level.

Owing to the numerous and very powerful springs, the closure of the last piece of foundation was a work of extreme difficulty and necessitated very special measures. In order to obviate any chance of cavities under the foundation, holes were bored at every 3 to 4 metres distance apart, and liquid cement poured into them.

Some idea of the difficulties with which the Engineers at Asyut had to contend, may be gathered from the fact that 974 springs were dealt with during the construction of the foundations, 284 of which were encountered in the season of 1901.

By the end of last year, the superstructure was completed, with the exception of a small portion of the parapet. It is expected that all will be completed by February, 1902.

The Ibrahimiyeh Canal Head and Lock.

The diversion of the canal, for the construction of this work, was only commenced in the end of November 1900, but progress was so rapid that, by the flood, it was possible to close the diversion and to pass the water through the new regulator and lock.

By the end of the year, the masonry was practically completed, the gates alone remaining to be supplied.

A successful piece of river training was carried out in 1901, by which the deep channel of the Nile was diverted from the east bank, to the centre and western bank.

The total expenditure on the Asyut Weir, up to the end of 1901, has been £794446 of which £232740 was spent last year.

REPAIRS TO THE PHILÆ TEMPLE.

In connection with the Reservoir, it was decided to consolidate the foundations of the monuments, in order to reduce to a minimum any risk of subsidence, when the water-level rises in the lake formed above the new dam. A credit of £E.22000 was asked for, and was granted by the Caisse in the latter months of last year. Special experts were brought out from England and work was commenced in November 1901, a sum of £E.3499, being expended to the end of that year.

Mr. Webb, in his Report, gives a detailed account of the work. I have myself, at different times, written a good deal on this subject, and will therefore confine myself to a very brief mention of this interesting operation.

The method adopted for strengthening the foundation, is what is known as "under-pinning," i.e., introducing sound masonry, underneath that of the old foundations, in such manner that these last shall rest upon a solid base. Wherever it was feasible, the new masonry was carried down to the solid rock, but where, on account of the great depth of excavation, this was impracticable, it was everywhere brought down to the present "saturation" level of the sub-soil, below which level it is not expected that any subsidence will occur. The new masonry was, in all cases, laid in cement-mortar. In the colonnade, where cross walls existed, steel girders were introduced under each column. These girders were, again, embedded in masonry, and finally, cement-grout was poured in, to fill up the interstices.

The following was the programme finally decided upon:—

To "underpin" the following down to prevent saturation level (R.L. 97·00):—

(1) The Eastern colonnade.

(2) The Western colonnade and the Temple of Nectanebo, with the steel girders as above-mentioned.

(3) The Kiosk.

(4) The Temple of Hathor.

(5) The foundations of the gateways of Hadrian and Adelphos.

(6) The East colonnade and room, of the entrance court of the Isis Temple.

The foundations of the great Temple of Isis, were originally carried down to solid rock, so require no strengthening.

In addition to the above, the mud buildings of the Coptic village are to be removed and the terraces drained, and revetted with stone.

By the end of the year, good progress was made. The West colonnade was completed and a good start was made on the East colonnade and Kiosk. It is expected that the work will be completed in June, 1902.

Great praise is due to Dr. Ball, who was in charge of the work, and to Mr. Talbot, the expert brought out from England. The task before them was one of considerable difficulty, as the weight of the masonry to be supported was very great, and the depth of the excavation, beneath the existing foundations, was, in some instances, as much as 10 metres. Until this space was refilled with masonry, the entire mass above had to be supported upon timber shoring. To add to the difficulty, the stability of the superstructure was, in many places, very questionable.

That this work should have been done, without displacing a single stone from any of the existing Temples, is a feat of which Messrs Talbot and Ball may well be proud.

Once the work is completed, there can be no doubt that the Temples will be far safer than they ever were before. Had nothing been done to them, portions of them must have subsided at no distant future, even without any rise in the water-levels of the river. Now, there is every reason to hope that they may be preserved for a long period of years.

The successful record of progress made last year, at Aswan and Asyut, reflects the highest credit upon the entire staff employed. It is, indeed, difficult to speak too highly of their work. Mr. Webb, the Director General of Reservoirs, controlled and directed the entire operations in a most able manner. The Resident Engineers, viz., Mr. Fizmaurice at Aswan, and Mr. Stephens at Asyut, carried out the very arduous task entrusted to them in a manner beyond praise. The Public Works Department suffered a heavy loss, by the departure of Mr. Fitzmaurice to take up the post of Engineer to the London County Council. Fortunately, a most efficient substitute was available in his first assistant, Mr. May, who has been appointed to his place. While mention is made of the remarkable services rendered by the Government Engineering Staff, an equal amount of praise must be accorded to the representatives of Messrs Aird and Son, viz., Mr. John Blue at Aswan, and Mr. McClure at Asyut. These two gentlemen have laboured incessantly in the interest of the Egyptian Government, as well as of their own firm, and the result of the year's operations bears the highest testimony to the success of their labours. Again, Mr. Tabor, the representative of Messrs Ransomes and Rapier, has an equally good record to show for 1901, in the shape of the very excellent progress made with the erection of the ironwork of the Aswan dam.

Throughout the year, Sir Benjamin Baker, the Consulting Engineer to the Egyptian Government for these works, has devoted much time to the consideration of the many problems set before him. He visited them, twice, during the course of 1901. Egypt owes him a considerable debt for the exceptional services he has rendered in connection with the Nile Reservoirs.

THE IRRIGATION STAFF IN 1901.

Yearly, in concluding my Report upon the year's operations, I have to say a few words regarding the very competent staff, whose labours it records.

The difficulty I find is, when everybody has worked so well, to express my opinion in a few words. Many names deserve mention which must be omitted, partly owing to want of space, and partly, because a selection must necessarily be, to a certain extent, invidious. If then the junior officers of the Department, who have worked so hard and so well, do not see their names mentioned, they must not conclude that this omission is due to any want of appreciation upon my part. They must be content with knowing that words of praise applied to their chiefs, are collectively applied to them also.

It has been pointed out, that the year 1901 was one of low summer supply and of poor flood, and that, consequently, while heavy pressure fell upon Lower Egypt during the first half of the year, the position was reversed during the flood, and Upper Egypt in its turn bore the strain.

That, in spite of the above, a cotton crop almost equal to the largest yet recorded should have been gathered, and that the area of "Sharaki" land should have been limited to a few islands and foreshores, is a result, with which Major Brown and Mr. Verschoyle, the Inspectors General of Lower and Upper Egypt, respectively, have every reason to be satisfied. It is to these two Officers that these satisfactory results are due. Each of them had a very heavy season's work, as, in addition to directing the irrigation operations, each had to supervise the construction of the large number of important works which have been briefly alluded to in the preceding pages. They were ably seconded by the Inspectors of Irrigation, of whom I must make special mention of Messrs Clowes and Dupuis. Both these gentlemen were called upon, during a portion of the year, to act as Inspector General, in addition to carrying on the direction of their own circle.

Mr. Langley's health unfortunately broke down, and he was obliged to absent himself from Egypt during the greater part of the year. Mr. Molesworth acted for him.

Mr. Williams, an officer of the Indian Irrigation Service, was appointed to the 3rd Circle of Irrigation, in the early months of last year. To take up such difficult duties as those entailed by a year of low Nile, without any experience of the country, or knowledge of the language and the people, was a high trial, but Mr. Williams came out of it most successfully, and promises to be a valuable addition to the Egyptian Irrigation Service.

The Egyptian Irrigation Inspectors, viz., Mahmud Bey Sidki and Hussein Bey Wasif, rendered excellent service in controlling the irrigation of their respective charges, while Ismail Bey Sirri, the Inspector of the Projects Circle, can show a record of progress for the year which it would be difficult to surpass.

The entire subordinate staff, both European and Egyptian, well merits the thanks of Government, for the satisfactory results which it has been instrumental in obtaining, in last year's Irrigation Season.

Part II.—WORKS OTHER THAN IRRIGATION.

I.—THE TOWNS AND BUILDINGS SERVICE.

The following tables show the sums expended, by this Branch of the Public Works Department, in 1901. On pages 4 and 5 of this Report, the expenditure, as a whole, has been given. These tables merely explain it in further detail. The disbursements for the year were distributed under the following heads :—

	£E.	Mill.
(*a*) Ordinary Budget	228356	025
(*b*) Special credits granted by the Caisse de la Dette	183534	222
(*c*) Special funds provided by other Departments ...	14311	490
(*d*) Special works executed from Revenue...	10889	993
Total	£E.437091	730

This figure is larger than that of 1900, by £E.44709,084 mill.

Each of the above items shows an increase.

The details are as follows :—

(*a*) ORDINARY BUDGET.

	£E.	Mill.
(1) General Direction	22591	254
(2) Public Buildings	80064	463
(3) Cairo City	27663	042
(4) Provincial Towns	46269	058
(5) Scavenging and Watering	25452	000
(6) Gas	19609	441
(7) Ezbekieh Gardens	2285	794
(8) Miscellaneous	4420	973
Total	£E.228356	025

Or an increase, over 1900, of £E.6957,069 mill.

I will very briefly discuss each of the foregoing items.

(*1*) *General Direction.*

This calls for no special remark. The sum represents the salaries of the Permanent Staff.

(2) *Public Buildings.*

The following is the distribution of the charges:—

	£E.	Mill.
Temporary Staff	928	016
General charges	5491	571
Materials and Plant	1079	866
Repairs and Maintenance	72565	010
Total	£E.80064	463

The first three items call for no special explanation. The expenditure is slightly in increase of the previous year, but not sufficiently so to necessitate any detailed description of the reasons for the increase.

The last item, viz., "Repairs and Maintenance" is an important one. In my last year's Report, I enlarged upon the inadequacy of the funds available for the up-keep of existing Public Buildings. As I then explained, the greater portion of these buildings are of great age and were, moreover, badly designed and badly constructed. Mr. Perry shows that comparatively few buildings are of as recent date as the year 1890, and that the majority go back as far as the year 1833.

These older buildings, he criticises as being "all defective." There are no damp courses. The foundations are constructed of inferior material. The walls, though thick, have no bond, and the mortar is composed of rich lime, with very thick joints. The timbers are, as a rule, too light for the spans, and sanitary arrangements are most primitive. The majority require complete reconstruction. Any satisfactory, or lasting, repairs are impracticable. Money spent upon these buildings, is money thrown away. All that the Service can do is to patch them up, and endeavour to make them last until funds can be found for gradually replacing them by new ones.

In very few instances do record plans of these old buildings exist. Consequently, when important work has to be done to any of them, a new set of plans has to be made. This involves a very considerable amount of work.

In 1901, four hundred and twenty-three Government buildings were repaired, for the sum indicated in the Table. A very large proportion of the money was devoted to re-roofing, i.e., to replacing the defective old roofs by new ones. £E.2202, was spent in this direction on the Ras El Tin Palace, alone.

I alluded, in last year's Report, to the repairs of the Mansur Prison, a portion of which failed in 1900. The causes of this failure were then briefly described. It is, consequently, unnecessary to do more than repeat the opinion which I then expressed, viz., that the officer, in charge of the work, was much to blame for having permitted inferior stonesto be placed under the bases of the iron columns.

Mr. Perry gives a detailed account of the repair operations. This account, which is accompanied by drawings, is very interesting and describes clearly the method employed. The undertaking was a bold one, as the prison is a four-storied building; the corridors, in each story, being supported by cast-iron columns, one above the other. On the top, is a Police Barrack. The inferior foundations were, in every case, removed and replaced by sound ones, and the columns of the lower story were replaced by new ones, without causing any accident, or the least subsidence, in any portion of the structure. Moreover, the prisoners, and the Police-guard, occupied the building, as usual, throughout the operations. This successful result reflects much credit upon all those concerned in it. The total cost of these repairs was £E.1068.

During the last few years, much has been done towards the improvement of the Public Buildings in Egypt, as is testified by the handsome and commodious structures now to be seen in Cairo and in many of the Provincial Towns. Nevertheless, much remains to be done, before the different administrations can be said to be properly and safely housed, and a large expenditure will have to be met before this result is attained. Meanwhile, the annual repairs budget must be applied to maintaining the existing buildings as far as the funds will allow. It must not be forgotten, however, that all buildings, even those of the best design and construction, require an annual sum for their maintenance, if they are to be preserved from decay and from falling into disrepair. If, as I said last year, the estimated money value of the existing Public Offices in Egypt, be taken into account; the annual allotment for repairs falls to a percentage far below that allowed, under similar conditions, anywhere in Europe.

Again, the sum in question, large as it appears to be, does not represent that actually available for expenditure, upon actual repairs. Many charges, which considerably reduce the total, have to be met from it.

(3) *Cairo City.*

The following are the details :—

	£E.	Mills.
Temporary Staff	736	400
General charges	677	350
Plant and Materials...	1884	107
New Works	2331	984
Repairs and maintenance	22033	201
Total... ... ... £E.	27663	042

This total is less than that for 1900, by £E.3109,410 mill. The reduction is almost entirely in the item of "Plant and Materials."

The above expenditure represents that of the construction and repair of roads, together with the up-keep of gardens, squares, avenues, etc. The total is utterly inadequate for the wants of the city, as the following figures, regarding the roads, will show :—

The total road-surface of Cairo, is 2,803,482 square metres. Of this area, only 1,378,610 square metres are metalled, the balance consisting of earthen roads.

By degrees, and as funds allow, the material, used for metalling, is being changed, and basalt is being substituted for the soft limestone formerly used. In 1901, 55619 square metres of limestone road were broken up, and replaced by basalt metalling. The total area of basalt roads now existing, is 315938 square metres, or not much more than one-ninth of the total road area of the city.

The first cost of the basalt road is higher than that of the limestone roads, but the former wear infinitely better than the latter, and also produce a better surface. As a step towards improvement, 21740 square metres of earth-roads were macadamised, with limestone, in 1901. Funds did not permit of basalt being used for this purpose. Mr. Perry, in his Report, gives a series of tables, showing the cost of the different kinds of road construction and repairs. It is only by the most rigid economy that he is able to keep the Cairo roads in as good order, as he does.

The Caisse de la Dette has granted a credit of £E.20000 for laying down certain roads, in the native quarters, with asphalt, in 1902. If this is a success, it is proposed to gradually introduce this method, of ensuring a good road surface, throughout the city.

Gardens and Nurseries.—These cost a total of £E.1996, excluding the Ezbekieh Gardens, which will be mentioned separately.

The Ghezireh Grotto.—This place, which for many years had fallen into disrepair, and which formerly bore an evil reputation, has been taken in hand by Mr. Perry, and transformed into one of the most charming spots in Cairo. The gardens have been laid out with much taste, and enlarged considerably. The old tanks have been repaired and supplied with plate-glass, while water is laid on throughout the entire area. It is proposed to form an aquarium here, for the different kinds of Nile fish. This, in addition to the beauty of the gardens, ought to attract visitors. It will be open to the public in the autumn of 1902. The expenditure for 1901, was £E.2398.

(4) *Local Commissions in Provincial Towns.*

The following was the Budget expenditure for 1901 :—

	£E.	Mills.
Temporary Staff	616	527
General charges	769	403
Materials and Plant...	49	124
New Works	142	309
Repairs and Maintenance	44691	695
Total... ... ... £E.	46269	058

This exceeds the expenditure of the previous year, by £E.4498,664.

These sums are controlled and expended by the local Committees of the different Provincial Towns. These Committees again, are controlled by a permanent Committee, which sits at Cairo, and examines all proposals for expenditure, exceeding a certain given small amount.

The sums, at the disposal of the Committees, were chiefly devoted to the opening up of new streets and the filling up of hollows. The towns on the Suez Canal, viz., Port Said, Ismailia and Suez, together with the town of Mansura, are in a different category from the others. Those on the Canal, are exempted from the control of the aforesaid Permanent Committee, and the Ministry of Public Works directs their expenditure. The town of Mansura has a Municipality of its own, which possesses powers more extensive than those granted to the local Committees, but still strictly limited. The sum at its disposal, in 1901, was £E.13464, of which it expended £E.12765 during the year, chiefly on paving, water supply and electric lighting. In all, twenty-four towns have now Local Committees, including Mansura.

Mr. Perry, reports favourably, on the whole, upon the progress made, but says : "As a general rule, the Local Committees still show "a tendency to prefer luxuries to necessities. It seems absurd to "devote a large proportion of the small permanent budget, to the "introduction of electric light into a town full of poisonous Birkets, "with no adequate water supply or drainage, and devoid of paved "streets, latrines, or a well organised Scavenging Service. The Interior "might lay down, as a rule, that these refinements should follow and "not precede the introduction of the rudiments of civilisation."

Concessions for electric lighting have been given for Helouan, Zifta and Tanta. Schemes for the lighting of Medinet El Fayum, Suez and Damanhour are under consideration.

The project for Zifta and Tanta, differs from the others, inasmuch as it is to be provided from a central generating plant, situated mid-way between these two towns, which are some 43 kilometres apart. The power will also be distributed, when required, for pumping and other industrial purposes, along the line. Electricity will be transmitted by means of an over-head wire. This experiment is interesting, as being the first instance, in Egypt, of an attempt at transmission of power, for a long distance.

Works, for water supply, have been undertaken at Aswan and Kena, while similar projects for Kafr Zayat and Beni Suef are at present being studied.

At Aswan, the water is raised from the river, and pumped into a reservoir, some 37 metres above low-water level in the Nile. From the reservoir the water is delivered, by pipes, to the town. The cost of the works, when completed, will be some £E.4100.

The Kena project is practically completed and has cost £E.4101.

The total lift, at this place, between the low water-level of the river and the reservoir, is just under 15 metres. The reservoir has a capacity of 960 metres cube, and the distance from the pump, to the reservoir, is a kilometre and a half.

(5) *The Scavenging and Watering of Cairo.*

The work done by this Service has been so frequently described in previous reports, that my present remarks will be of the briefest. There was no increase in the area in 1901. 61% of the total road surface is cleaned and watered daily, while the remaining 39% is cleaned and watered once in every four days.

There were no changes in the working staff. The total number of animals employed was 421., The price of fodder was abnormally high, in 1901 and the keep of these animals consequently cost considerably more than in previous years. In order to meet the deficit, thus caused, a transfer of money was made in 1901, from the regular Budget Reserve.

An arrangement has been made, by which this entire Service, with its budget, was transferred to the Sanitary Department, from the 1st of January, 1902. It seems probable that this will result in an economy in working, and the change was certainly advisable, as the Sanitary Inspectors of Cairo, will be able to supervise this Service as well as their own. The work itself is one which should properly be controlled by the Board of Health.

Messrs. Powell, Fitzpatrick and Badr Effendi did excellent work in

1901, in connection with this Service. So also did Mr. Keith, who is in charge of the town stables.

(6) *The Lighting of Cairo.*

Gas.—There are now 3233 lamps in the city, or an increase of 62, as compared with 1900. Arrangements are being made, for still further increasing this number in 1902. A grant of £E.2000 has been made, whereby 295 lamps can be added to the total. Those parts of the city, where lamps are most urgently required, have been selected for the extension.

The expenditure for 1901, was £E.19610, as against £E.20356, in 1900.

Electric Lighting.—During the year, the lamp connection was increased by 28 per cent. This increase was equivalent, at the end of the year, to 62500 lamps of eight candle power. The connected number of subscribers increased by 36 per cent. Ten kilometres of high and low-tension cables were laid in order to meet the demand. The high-tension cables are tested by the Public Works Department before connection. For low-tension cables, the maker's certificate is considered to be sufficient.

The year 1901, is the first, since the commencement of the concession, in which no break-down took place in the current supply.

The Khedivial Opera House has a separate generating plant of its own. This is worked by a European firm, and supervised by the Public Works Department.

Monsieur Jacot, the Government Electric Engineer, has rendered excellent service in controlling the different concessions and in examining and studying the different projects submitted. His work is very heavy, as it includes the Cairo Tramways and Telephones, as well as the electric lighting of the city. Further, all projects for Provincial Towns are submitted to him for study.

(7) *The Ezbekieh Gardens.*

The receipts were £E.1135 in 1901, while the expenditure, including water and gas lighting, was £E.2244. A deficit of £E.1109 consequently resulted. Mr. Perry attributes the falling off in the receipts to the fact, that the garden summer theatre was closed for some time for repairs, and also to certain difficulties connected with obtaining the services of the Egyptian Military Bands.

(8) *Miscellaneous Expenditure.*

This is composed of a number of small items and calls for no special mention.

(b) EXPENDITURE UNDER SPECIAL CREDITS, PROVIDED BY THE CAISSE DE LA DETTE.

The following is the general distribution :—

	£E.	Mill.
The Cairo Court of Appeal	5173	109
Alexandria Tobacco Store..	1774	470
Cairo Arab Museum and Library...	10566	555
Cairo Egyptological Museum...	24253	128
Sundry New Public Buildings.	119299	615
Cairo, storm-water drainage	17673	250
Road at Rod El Farag	1622	441
Repair to ancient Arab monuments	3171	654
Total...	£E.183534	222

The last item, although inscribed in the Budget of the Public Works Ministry, concerns expenditure which is only indirectly controlled by that Administration. The details of this expenditure are directed by a special Committee, which publishes its own annual report, upon each year's operations.

THE CAIRO APPEAL COURT AND PRISON.

This building is now complete and has been occupied by the Ministry of Justice for some time. The total cost has been £E.109000, and the expenditure, in the above table, refers to fittings, furniture, etc. The new Court is a handsome and roomy structure, with a prison for 300 prisoners attached. It is excellently situated, close to the offices of the Governor of Cairo, but, unfortunately, is in far too close proximity to a mass of unsightly houses. It will be necessary, some day, when funds permit, to buy up these buildings, and to form an open space around these courts.

ALEXANDRIA TOBACCO STORE.

This is an addittion to the existing stores, which have proved insufficient. The area, covered by the new building, is 4000 square metres. The roof, flooring and columns are built of "Béton Armé." Work was begun in September, 1901, and should be completed by March, 1902. The total estimated cost is £E.12500.

THE ARAB MUSEUM AND LIBRARY (CAIRO).

£E.47018 has been spent upon this building up to date. It is rapidly approaching completion, and it is expected that the transfer of the collections can take place in 1902. "Béton Armé" has been employed in the floors and lintels. It is a very handsome structure with striking façades. The style of the architecture is Saracenic. The total estimated cost is £E.50000.

THE EGYPTOLOGICAL MUSEUM (CAIRO).

This building is practically completed, and has been handed over to the Museum Authorities. At the time of writing, the transfer of the collection, from the Giza Museum, has been very nearly accomplished. Little work now remains to be done, beyond the completion of the enclosure wall and railing; the houses for the staff and stores, workshops, etc.

The total estimate is £E.218953, of which £E.198395 has been spent up to date.

It is proposed to open this Museum to the public, in November, 1902. The lighting arrangements have given a considerable amount of trouble, not from the usual cause, viz., want of light, but from the reverse. It has been found necessary to close a considerable number of the windows in the upper story, and experiments are in progress for reducing the area of the top-lights.

SUNDRY NEW PUBLIC BUILDINGS.

The list of these is a very long one, and I will merely allude briefly to the more important buildings.

The Cairo Geological Museum.

This has been taken over, and completed, at a total cost of £E.4160.

The Lady Cromer Memorial Foundling Hospital.

This has also been completed, at a cost of £E.2500.

Customs Sheds (Alexandria).

These consist of ten large sheds, on the Quays, covering a space of 9166 square metres. They are for the purpose of protecting the marchandise, when landed from the ships, from the weather. These sheds are constructed entirely of iron, upon a concrete foundation. In two instances, piles were used in the foundation. Their estimated cost is £E.16056, of which £E.14895 was expended 1901.

The Port Said Gouvernorat.

The west wing of this building was completed in 1900. The central block and the east wing, are now under construction. Good progress was made in 1901, and the masonry, at the end of the year, was well above ground. The estimate amounts to £E.13000, of which £E.2411, represents the expenditure for 1901.

Cairo Central Fire Station.

This station is to contain five fire-engines, with barracks for the firemen, and stabling for twelve horses. The total estimate amounts to £E.2500.

Unfortunately, the foundations have turned out to be extremely bad. The soil here consists of rubbish and debris, to a considerable depth, and the site is seamed with a net-work of old sewers. It has been decided to apply the "Béton Armé" system here. The delay was unavoidable, but the progress for the year was, in consequence, but small, and only involved an expenditure of £E.1096.

Cairo Post Office (Annex).

This was completed in 1901, at a cost of £E.12297.

Port Said Post Office.

Good progress has been made. £E.4827 was spent in 1901, out of a total estimated cost of £E.25000.

School of Law (Cairo).

Here also, the foundations have turned out to be bad. This is the case with many of the public buildings of Cairo. Special precautions were consequently required and delay was thus caused. Work will, however, be pushed on rapidly in 1902. This School, which will accommodate over 100 pupils, is estimated to cost £E.22100. £E.1560 was spent in 1901.

Cairo Girls' School.

Owing to the same cause as above, viz., bad foundations, work was not commenced in 1901. It will be begun in 1902.

Shebin-el-Kom, Summary Tribunal.

This was commenced in 1901 and will be completed in the current year. The cost, up to date, has been £E.3019.

Agricultural College (Cairo).

Good progress was made in 1901, and it is hoped that the buildings will be completed in 1902. The estimated cost is £E.17953. At this site also, much trouble was experienced with the foundations.

The Mubtadian and Dar El-Ulum Schools (Cairo).

These works were completed in 1901. The expenditure for the year, being £E.6000.

Government Printing Press (Cairo).

This work is now completed, at a total cost of £E.15128, of which, £E.7000 represents the expenditure for 1901. The old building has been entirely reconstructed, with the result, that handsome and serviceable offices, lighted throughout by electricity, have replaced the former very defective ones. A house for the Director has also been built.

"Béton Armé" was largely used in this construction. This work was controlled by the Engineers of the Public Works Department, but much of the credit must be given to M. Chélu Bey, the Director of the Printing Offices. He has personally supervised most of the works, and it is largely due to his energy that they have been carried out so cheaply and so well.

The Cairo Zoological Gardens.

Two new lion-houses were constructed, at a cost of £E.4329. The Director's house was enlarged and the elephant stables completed, for an expenditure of £E.1700.

The Bulac Town Stables (Cairo).

These buildings are designed to take the place of the stables and offices, which were handed over to the Army of Occupation, when the arrangements in connection with the land for the Egyptological Museum were made.

The sanctioned design and estimate allowed for *eleven* sets of stables. These were to cost £E.10000.

It is regrettable to have to state, that the estimate, as prepared by the Building Department, was far from accurate, and contained many omissions. The result has been, that only *seven* sets of stables have been completed, while £E.9000 of the total credit, has been expended! Consequently, the service is short of its requirements, by *four sets* of stables, and, at the same time, has only at its disposal a credit of £E.1000, with which to build them! Lengthy explanations have been made to me of the reasons for this fiasco. I cannot consider any of them to be satisfactory, and the result is not creditable to any of those concerned.

In addition to the buildings mentioned above, many smaller works (chiefly in the Provinces) such as Police Barracks, Government Offices, etc., etc., were in progress during the year just past.

The sum, given in the table, includes the expenditure controlled by the Prisons and Sanitary Departments. The latter Service entirely supervises its own works, by its own special Engineers. In the case of the Prisons, however, the Public Works Engineers still exercise a certain amount of superintendence. Mr. Perry criticises this arrangement, and suggests, that, in order to get rid of the present dual control, which at times produces friction, it would be better that the Prisons Department should follow the system adopted by the Sanitary and Quarantine Services, and entirely control its own constructions, by means of its own Engineers, merely submitting the designs to the Public Works Department for check and approval.

I agree with Mr. Perry.

"Béton Armé."

Before leaving the subject of buildings, I would wish to draw attention to an interesting note presented by Mr. Perry, in his attached Report, upon the employment of the above system, in Egypt.

He shows how largely it has been used, and the economy, as well as the efficiency, which has resulted from its application to our buildings.

This is more particularly the case, where, as in Cairo, the foundations are bad, and buildings of great weight have to be founded upon a mass of debris and refuse, the accumulation of centuries, which covers the solid soil, to a depth of many metres.

THE CAIRO STORM-WATER DRAINAGE.

This is described in much detail, by Mr. Perry, in his accompanying Report.

Work was commenced on the 8th June, 1901, and completed by the 29th of November of the same year.

The total length of drain is 8,055 metres.

Of this:—

2837	metres are	masonry sewers.
880	,,	concrete pipes.
3610	,,	stone-ware pipes.
728	,,	junction pipes.
8055	metres.	

135 gullies, 187 man-holes, 3 syphons, and a masonry out-fall sluice were erected. The work was carried out under high pressure, owing to the necessity of completing it before the period of annual storms. Moreover, in the native quarters of the town, the narrow width of the streets greatly increased the difficulties of working. Many of these streets are only from 4 to 6 metres wide, and the excavation trench descended, in places, to 5·5 metres below the road-level. It is easy to comprehend that work, under such conditions, was both difficult and dangerous. Most of the adjacent houses had to be shored up by heavy timbering, their foundations, as a rule, being extremely shallow. The earthwork, also, was very expensive, as it had to be carried, in baskets, along a narrow bank, on either side. Lastly, the infiltration water gave much trouble. Much of the work was executed, at night, and by lamp light. The Tramway service was not interrupted for even a day.

The total expenditure was, as given in the Table 8, but this does not include all charges. It is expected, however, that a total of some £E.21000 will be sufficient, which is considerably less than the credit allowed. The rainfall, in the winter of 1901-1902, was not very heavy, and therefore these works were not fully tested. It was, however, sufficient, to prove that the drains functioned excellently. The water ran quickly off the streets and was discharged into the old canal at Kasr El-Nil.

The execution of these works was entirely supervised by Mr. Reboul, the Director of the Cairo Tanzim Service. Very great credit is due to him for his energy and untiring labour, without which, completion could never have been secured in such a short period of time.

ROD-EL-FARAG ROAD.

This expenditure represents a portion of that required for carrying a metalled road down to the new grain stores and quays, situated at Rod-el-Farag, north of Cairo. A large number of river boats now discharge their cargoes at this place, and it was indispensable to provide them with a good cart road, by which produce could be transported to the City and Railway. An arrangement has been made with the Tramway Company, by which the latter will run a branch of their system to these quays. The estimated cost of this road is £E.5390. It will be completed in 1902.

(*c*) SPECIAL FUNDS PROVIDED BY OTHER DEPARTMENTS.

The list of works carried out, under this head, is a long one. Thirty works, most of them small, were completed for the expenditure given in the table, on page 54 of this Report, viz., £E.14311,490 mill. Space does not permit of my describing them all here, and they are all detailed in Mr. Perry's tables. I will then only mention those works costing more than £E.1000, i.e., six in all.

These works were:—

	£E.	Mill.
Coastguard sheds at Alexandria (Finance Ministry) ...	1200	000
Pipes at Bulac Dacrur station (Railway Administration)...	1395	542
Bulac Printing Office (Finance Ministry)	1937	903
Tanks, Gezireh Aquarium (Finance Ministry)	1005	573
Beni-Suef Offices and Police Barracks (Interior Ministry).	1779	805
Iron railing, Gezireh Garden (Finance Ministry)	1378	276

None of the above call for any special description.

(*d*) SPECIAL WORKS EXECUTED FROM ORDINARY BUDGET.

	£E.	Mill.
Cairo City	4495	077
Maintenance works	6351	216
Provincial Towns	29	112
Ezbekieh Gardens	14	588
Total	£E.10889	993

None of these items call for any special remark.

THE DRAWING OFFICE.

43 projects, estimated to cost £E.268396, were prepared in 1901. 1,080 plans were issued.

20,533 copies of drawings were issued to contractors, to works, and to different Services. From the 1st of January, 1902, a change has been made, whereby the Chief drawing Office has been decentralised; only a portion of the work remaining under the direction of the Chief Architect, the rest being distributed, with the necessary staff, to the charge of the Officers who actually control the construction of the buildings. This change, *if properly carried out*, will undoubtedly lead to an economy of time, in correspondence, and in preparation of the projects.

THE CAIRO ELECTRIC TRAMWAYS.

The record, for 1901, is a satisfactory one.

No new lines were made.

The mean daily number of passengers carried, has increased from 38811 in 1900, to 40315 in 1901. This last figure represents rather over 7 per cent of the total population of Cairo.

	Metres
The total length of existing single line	14,944
" " " double line	20,947
Total	35,891

The rolling stock consists of 94 motor cars and 59 trailers.

An overhead bridge is in course of construction upon the Pyramid road at the point where the Tramway line crosses the Government Railway.

THE CAIRO TELEPHONES.

Up to last year, overhead wires, with an earth-return system, existed throughout Cairo.

With the introduction of through telephonic communication between Alexandria and Cairo, it was found necessary to introduce underground cables, with metallic currents. A new license was consequently granted, by the Government, to the Company, authorising them to make this change. The Government reserves to itself the right of withdrawing this license at any moment. In streets containing more than one cable, these must be laid in solid cement conduits. Single cables may be laid without pipes, if steel-armoured.

THE HELUAN WATER-WORKS.

	£E.	Mill.
The receipts for 1901 were	3486	260
The expenditure...	2130	000
Gross profit	£E.1356	260

The whole town is now supplied directly from the mains.

253,883 metres cube of water were supplied by the pumps, in 1901, of which, 147,885 metres cube were taken by private individuals, and the balance by the Government Services.

GHIZEH AND GHEZIREH WATER-WORKS.

	£E.	Mill.
Total receipts for 1901	7098	343
„ expenditure	6010	980
Gross profit	£E.1087	363

Out of the above expenditure, £E.1420,520 mill. represents the cost of a 6½ H.P. oil engine, required for the workshops, and 1,600 metres of pipe laid down in the Pyramid road.

All buildings were repaired and wood-work painted.

£E.500 were allowed for the partial water supply of the town of Giza. Of this £E.410 was expended. 1,418 metres of pipe were laid and a standard erected for the sale of water.

THE STAFF IN 1901.

It will be seen, from the foregoing pages, that this Service can show a good record of work for the year under discussion.

Mr. Perry has, as usual, directed it ably, and has worked hard at a very difficult task. Unfortunately, his health broke down during the latter quarter of the year, and he was obliged to take leave of absence. Mr. Sayyed Bey Choucry acted for him.

Messrs. Clifton and Hewat, the Chief Inspectors of Buildings, had a heavy season's work. They were well seconded by their subordinates, among whom I wish specially to mention Messrs. Pastour, Ehrlich, Watson and de Cosson.

Mr. Chapman also did good service.

I have already alluded to Mr. Reboul's excellent work, and I wish to place on record, the name of Mr. H. Curtis, of Giza, who has, as always, done first-class work.

Mr. Manescalco Bey, the Chief Architect, has, as I have shown, prepared a large number of important projects.

II.—THE SURVEY DEPARTMENT.

Captain Lyons' Report of the work done last year, by this Service, is a very full one, and contains much interesting detail. It is an excellent record and, of itself, is a proof of Captain Lyons' powers of administration. The range of his work is a wide one, and one that is yearly increasing in extent and importance. He has been most ably seconded by his small staff of highly-trained experts.

The Report in question contains much technical detail. I will briefly allude to those portions of it which seem to me to give the best general idea of the year's work.

The Survey Department is now divided into six separate Branches:—

(I) The Land Survey, including the Trigonometrical, Revenue and Topographical branches.

(II) The Mapping Department, for the preparation and reproduction of maps and plans.

(III) The Observatory.

(IV) The Meteorological Department.

(V) The Geological Survey.

(VI) The Service for analysing and testing of materials.

The Land Survey.

Captain Lyons, for the first time, in his Report, gives a description of the methods employed in making this Survey. Previously to 1901, his note consisted merely of a record of work done, as it was not possible to form an accurate estimate of the actual cost of the work. In accordance with the Khedivial Decree of the 10th of May 1899, the Ministry of Finance requires that the survey of two entire Provinces shall be completed annually, and be ready for the work of reassessing the land-tax, by, at latest, midsummer of each year.

To effect this, not only must the maps be printed, but the land registers must be completed for an area of from 600000, to 700000 feddans, yearly. Unless every village, in the Provinces in question, can be reassessed before the end of the year, the imposition of the new rate of tax, for the whole Province, must be postponed for another year. It is easy to understand that this means a great press of work during those months when field work is possible. I leave Captain Lyons to describe the difficulties which arise, and will merely point out that one of the chief ones is the propensity of the villagers to remove survey-points. This practice frequently involves the triangulation of large areas, a second time. Another source of trouble is the incorrect method in force among the Egyptian village measurers, for calculating areas. Captain Lyons shows that, according to the methods practiced by the "Messahin," the area of a given equilateral triangle, works out to be 12·5 per cent larger than it should be, while in the case of a parallelogram, with an angle of 45°, the error is as much as 41 per cent in excess. This explains the large area which, by the new survey, has to be relieved of taxation, as being non-existent. A class of young Egyptian surveyors has been formed, and turns out some 90 men per annum. Only a small proportion of them, however, continue in the Survey Department, as they find it easy to obtain work elsewhere.

The approximate cost of survey per square kilometre works out as follows:—

	£E.	Mill.	
Survey...	6	217	
Register..	2	747	
Total... ...	£E.8	994	per square kilometre.

Captain Lyons hopes that this figure may, in future, be capable of reduction, but on the other hand, the cost of the Inspector's pay, instruments, materials and computation are not included in it.

The following is a very brief account of last year's work.

TRIANGULATION.

The major triangulation of the Provinces of Dakhaliyeh and Kalubia was completed. The minor triangulation will be ready early in 1902.

A base of verification was measured near Sherbin, in the north.

Major triangulation was commenced in the Provinces of Kena and Girga.

The computation of the work done the year before, in the Fayum, was completed in 1901.

The Revenue Sureey.

This was in progress, last year, in the Provinces of Menufia and the Fayum. About two-thirds of the area were completed. The detail survey of Gharbia and Ghiza was finished, and the reassessment of the land-tax completed by the end of the year.

The total area surveyed, between the beginning of 1900 and the beginning of 1902, was 1,107,276 feddans. Mr. Humphreys, who is in direct charge of this portion of the work, has done excellent service. His Inspectors have, under his tuition, improved both the quality and the rate of their work.

The mean cost of this work is as follows :—

		£E.	Mill.	
Records...	cost	1	154	per 100 feddans.
Field Work	,,	1	428	,, ,, ,,

And the number of days required for each of the above averages 5½ for the same area.

Captain Lyons' tables show how very largely the small holdings preponderate in Egypt. In the villages of which he gives a record, with the exception of Burillos and Sherbin, the proportion of holdings, of more than 5 feddans, is not more than from 2 to 5 per cent of the whole.

The Topographical Survey.

The progress, so far, has been small, but a commencement has been made with the preparation of topographical maps for the Irrigation and other Government Departments. The work chiefly consists in revision of the plane-table survey of the Delta Provinces, made between the years 1892 and 1897. Mr. Dowson, with six young Egyptians, is charged with this work and, by the end of the year, 34 sheets, each covering an area of 25 square kilometres, had been revised and produced.

The Mapping Department.

This Office is under the direction of Messrs. Wiltshire and Hansard, the latter of whom replaced the late Ravon Bey, when he was attacked with the illness which eventually caused his death, in 1902.

The staff consists of 17 Europeans and 54 Egyptians.

Captain Lyons remarks that it is almost impossible to procure either good lithographic draughtsmen, engravers, or head-printers, among the Egyptians.

The number of maps produced during the year was 1155, and of plans 175.

81809 copies of maps, and 111000 copies of plans were produced.

Interesting figures regarding the cost of production are given in Captain Lyons' Report.

THE CAIRO OBSERVATORY AND METEOROLOGICAL DEPARTMENT.

This Observatory is still situated at Abbassiyeh, until the new building, at Heluan, to which it is to be transferred, is ready. This establishment, under the direction of Mr. Wade, with Mansur Bey Sidky as assistant, has worked, in 1901, on the lines of the new organisation introduced in the year previous.

The magnetic observations at Heluan have been recommenced. A complete set is now taken weekly.

Observations in atmospheric electricity are now made regularly. This Observatory is now equipped to register, automatically, all meteorological elements as well as earth tremors.

The Standard Sidereal clock was sent to London, in 1901, for cleaning, and to be fitted with electric contacts.

Time-signals are now transmitted daily to Port-Said, Alexandria, Cairo (Citadel) and Wadi Halfa.

The observations for the year 1900, are now in the press, and will shortly be published.

The following meteorological stations, were equipped, during 1901, in Egypt and the Sudan. They were all visited by Mansur Bey Sidki, who verified the instruments and equipped some new stations.

The stations in Egypt are:—

Cairo, Alexandria, Port-Said, Barrage, Beni-Suef, Asyut and Aswan.

In the Sudan, they are the following:—

Wadi Halfa, Berber, Khartoum, El-Duem (White Nile), Wad Medani (Blue Nile) and Suakin.

In addition, rainfall is registered at Fashoda, on the White Nile, at Rosaires, on the Blue Nile, and at Kassala.

Lastly, a station has been equipped at Adis Ababa, in Abyssinia.

Telegraphic weather reports are sent daily from each of the above, except from Adis Ababa, and from the stations where rainfall alone is registered.

The daily wires from Beirut have been discontinued, owing to the irregularities of the Turkish Telegraph Administration, and to the very heavy cost.

Daily weather telegrams will shortly be exchanged between Alexandria and Cyprus, the Eastern Telegraph Company having kindly consented to despatch them free of charge. Captain Lyons states that the most difficult element to forecast in Egypt, is rain. Further, that a study of the daily weather-reports shows that changes in the meteorological conditions over the Mediterranean, rarely make themselves felt beyond Aswan, and that the meteorology of the Soudan may be worked out independently of that of Egypt proper.

THE GEOLOGICAL SURVEY.

This is under the direction of Messrs Barron, Beadnell and Hume. The two former were employed in the Fayum, and on the survey of the 2nd Cataract, while Mr Hume had charge of the transfer of the collection to the new geological museum. The work in the Fayum resulted in finds of the highest scientific interest.

In the spring of 1901, Mr. Beadnell, in company with Dr. Anderson of the British Museum, discovered fossil remains of a rich and, for the most part, totally new Fauna from the Upper Eocene Strata. In November of last year, he continued work, and found a magnificent series of fossil animals, in good condition. These have all been transported to the Cairo museum where they will be examined and described.

The following reports of the Geological Survey were published in 1901:—

The Oases of Kharga, Dakhla and Farafra.

The following are in the Press:—

The Geology of the Bahria Oasis.
,, ,, Eastern Desert.
,, ,, Abu Roash.
,, ,, Kurkur Oasis.

Also a report upon the Building Stones of Cairo.

Reports on the Sinai Peninsula, the Fayum and the Nile Valley are in course of preparation.

THE CHEMICAL LABORATORY.

A great deal of work was done in 1901, under the direction of Mr. Lucas.

342 analyses were made, comprising ores, building stones, materials, soils, water and miscellaneous.

By the end of the year, standard measures of length and weight were placed in a room at Giza, which will be fitted up for the verification of any weights and measures sent there for the purpose.

A stone crushing machine has been ordered, so that any tests required by the Public Works Department may be carried out.

The computing Office is under the direction of Mr. Craig. His work has been very heavy, and it is difficult to speak too highly of the services which he has rendered in this connection.

The following is the expenditure for 1901.

	£E.	Mill.
Permanent staff	14613	400
Temporary staff	17916	584
General charges	6248	761
Geological Survey	2709	127
Miscellaneous	400	000
Totals	£E.41887	822

Of this, a sum of £E.20173 is provided by the Ministry of Finance, for the revenue survey. The balance is met from the Public Works Budget.

III.—THE TECHNICAL SERVICE.

Mohamed Bey Anis, the head of this branch of the service, has, as always, controlled it in a very competent manner and maintained his high reputation as an Administrator.

The expenditure for 1901, excluding the Arsenal, was as follows:—

	£E.	Mill.
Permanent staff	5284	579
Temporary staff	2663	490
General expenditure	767	378
Materials and plant	1008	305
Repairs and maintenance of Government Steamers ...	4689	147
Total...	£E.4689	147

The details of the last item are as follows :—

	£E.	Mill.
Cost of working steamers	2250	886
Repairs and maintenance	2356	024
Petty expenses	82	237
Total...	£E.4689	147

This does not really represent the cost of the steamers. The actual sum, expended in 1901, was £E.6703,285 mill. The difference, i.e.,

£E.2014,138 mill., was found from the profits realised by work done in the Arsenal. The cost of coal, alone, came to £E.2677.

The three items of staff and general expenditure call for no special remarks. The totals follow very closely those of previous years.

THE GOVERNMENT ARSENAL.

This institution is entirely self-supporting. The expenditure for 1901, is thus distributed :—

	£E.	Mill.
Work done for Public Works Department	24278	000
„ „ „ other Government services	3313	000
„ „ „ private individuals	205	000
Cost of coal, oil, etc.	2678	000
Total...	£E.30474	000

The main items in the charge against the Public works services, were for steel and iron work. 516·5 tons of steel pipes were supplied at a cost of £E.8131.

	£E.
205 tons of cast-iron grooves costing	2226
Cast-iron piles for Zifta Weir cost	2263
3,302 regulating sleepers cost	2454

The balance was for miscellaneous works, including the construction of one house-boat, and five rowing-boats.

The rate of steel work in 1901 was £E.15·7 per ton, as against £E.17·6 in 1900.

This reduction is partly due to the reduced price of iron and coal, but also to the introduction of new labour-saving machinery into the workshops.

The following were erected in the shops in 1901 :—

An hydraulic rivetter, with accumulator and pump.

A steam shearing and punching machine.

An angle-iron bending machine.

A twist-drill grinder and a double-roller girder over-head crane.

The above cost £E.1900, but it is calculated that the economies realised from the introduction of this machinery will very shortly pay for their first cost. Already, this new machinery has reduced the rate of labour from £E.2,48 mill. per ton, to £E.2,03 mill.

The value of materials purchased, in 1901, was £E.18137.

Of this, Europe supplied goods to the value of £E.5074. The balance was bought locally.

Labour cost £E.4907, exclusive of the foundry. This has a separate account in which labour figures at £E.1284

Mr. H. Curtis has, for years, held charge of this establishment. It is difficult to praise his work too highly. It is in great measure due to his capable direction that the Government Arsenal is worked at a profit instead of at a loss.

THE SERVICE FOR THE REGISTRATION AND SUPERVISION OF STEAM ENGINES.

The effect of the new law for the above, has been very satisfactory. It has removed most of the former difficulties and has enabled the service to work independently, and without being obliged, as was formerly the case, to take legal opinion at almost every step.

The demands for steam-engine licences in 1901, was 323, as against 153, the year before. Proprietors are now obliged to report their Engines, if unlicenced, within a period of 60 days from the date of issue of the new regulations.

43 licences remained for consideration, at the end of 1900. 36 more were received through the Mudirias, making, with the figures first mentioned, a total of 402 for consideration in 1901. Of these, 336 were granted, pending their passing the necessary tests; 66 being held over for further examination.

235 engines were satisfactorily tested during the year, at the request of their proprietors.

Up to the 20th November, 1900, the date on which the new law came into force, only 614 engines were registered and in order, in accordance with the regulations. Since then, 20 more have been added, by the advice of the lawyers. These with the 235 engines, above mentioned, as having passed their tests, make a total of 869 duly licenced establishments.

Inspections of 661 engines were made in 1901. The Government now pays the cost of the first visit. If any more are necessary, the proprietor has to pay the charges. The steam-engine Inspectors have now been given limited Police powers, and have now the right to appear before the Courts and give evidence.

Since the issue of the Decree of 1900, 28 engine proprietors have been prosecuted in the native Courts, and 8 in the mixed Courts.

In the former, 8 were sentenced to stop working; 5 were fined, and 15 cases are still undecided. In the latter, 4 engines were stopped, one proprietor was acquitted, and 3 cases are still before the Courts.

Altogether, the state of things in much more satisfactory than in former days, when the old law was in force.

One boiler explosion occurred in 1901, fortunately without loss of life. The engine was an unlicenced one and it was found that the boiler had not been worked for 10 years! Also, that on the night of the accident, the driver left his fires well-lighted, and went to sleep!

The only other accident was at a European factory. A steam-pipe burst and killed three men. Three were sleeping on the top of the boiler and were all scalded to death.

A great deal of extra work has been thrown upon the supervising staff of late, and it has been found necessary to add two Assistant Engineers.

23 licences were granted for fixed engines for irrigation purposes. These with the 766 previously licenced, makes a total of 789. The fees received for these, in 1901 amounted to £E.182.

Anis Bey speaks very highly of the work done by Mr. Crawley, the Director of the steam-engine service. I can cordially endorse his words of praise.

Quarries.

At the end of 1900, 638 quarries were licenced. In 1901, 37 more licences were granted, bringing the number up to 675. 48 licences were cancelled, so that, at the end of 1901, the number stands at 627.

The fees realised in 1901 amounted to £E.617,550 mill.

THE CENTRAL STORES.

Value of materials and instruments purchased or made in 1901, amounted to £E.1227,169 mill.

	£E.	Mill.
Purchase in Europe	496	817
,, ,, Egypt	510	295
Made	220	057
Total... ...	£E.1227	169

Furniture was made and purchased to the value of £E.346,684 mill. and repairs to instruments cost £E.408,813 mill.

The value of stores delivered, was £E.1977, of which the irrigation service took £E.786.

IV.—THE MUSEUM AND ANTIQUITIES DEPARTMENT.

It gives me much pleasure to record the steady progress which has taken place in the working of all branches of this Department, thanks to the energy and great power of administration possessed by the Director General, Monsieur Maspero. The change has been remarkable, and the improvement, as regards the whole of this service, has been very evident.

Monsieur Maspero has presented a long Note of the work done last year. This Note I have attached to my present report. It is full of detail, and I can recommend it to all persons interested in Egyptology.

I will very briefly touch upon the main points which it contains. Thanks to a special credit of £E.578, granted by the Ministry of Finance, the Inspectors are now able to travel in the provinces more or less continually. The monuments are, consequently, far more regularly inspected than used to be the case.

Unfortunately, a steady deterioration is reported in many of the older monuments, more especially in the temples of Abydos, Luxor, Gournah and Edfu. This is largely due to natural causes, such as the decay caused by exposure to the weather. It has, however, according to Monsieur Maspero, been assisted by the removal of the earth which used to cover the structures. In such instances, repairs ought to have been undertaken without loss of time.

He also, gives an unsatisfactory account of the state of the famous Colossi, at Abu Simbel. It appears that tourits are in the habit of climbing on to the knees of these statues, for the purpose of taking photographs. This practice has caused the fissures in the stone to widen, and there is a danger that large fragments will shortly fall. If this be so, it would seem to be necessary to take steps to prevent such a practice, or even, if this be impossible, to close the temple altogether.

The expenditure for the year, under the regular Budget, was as follows:—

	£E.	Mill.
Permanent staff	6980	713
Temporary staff	2631	180
General expenditure	2723	462
Total... ...	£E.12335	355

To this is added :

	£E.	Mill.
Receipts from the Tourist fund	3213	450
Entry to the museum	601	150
Sale of objects	913	155
Sale of Sebakh	525	000
Total	£E.5252	755

It is satisfactory to note that the total of the last three items, exceeds that of the year 1900, by £E.1557,035 mill. The money derived from these sources is applied solely to the maintenance and guardianship of the temples, and does not appear in the Public Works Budget at all.

This expenditure is controlled by the Permanent Museum Committee, of which Monsieur Maspero is the President.

In addition to the above, a sum of £E.4000 was, as in 1900, granted by the Public Debt Commission, for the completion of the new museum catalogue, and the restoration of the Karnak Temples.

£E.1992 was spent upon the latter and the balance upon the catalogue.

£E.248,994 mill. was spent in 1901, upon the purchase of new volumes for the Museum Library.

Considerable progress was made with repairs in 1901. Many of the principal monuments are now closed by walls and gates.

A robbery took place in 1901, in the tomb of Amenhotep II, at Thebes. The robbers, who must assuredly have come to an arrangement with the guardians of this tomb, broke through the gate, and searched the royal mummy for treasure. Not finding any, they left the place, carrying off the richly painted wooden boat which was placed in the outer chamber, and which supported the body of a man. The Royal mummy, fortunately, was not seriously damaged. No trace of the boat has been found and although strong suspicions exist as to the identity of the perpetrators of this outrage, it is to be feared that the evidence sufficient to convict them may not be forthcoming.

A considerable amount of excavation was carried out in 1901, mostly by private societies, or individuals. These share the objects found with the Museum service. As it is far more profitable to the Department to get its digging thus done, every encouragement is given to those wishing to excavate. The demands for permissions are submitted to the Museum Committee and, unless there is some special reason against it, are readily granted.

The Museum Service carried out excavations, on its own account, in 1901, at a cost of £E.1660.

In all, 584 new objects were added to the collection, many of these being of considerable value. Monsieur Maspero mentions the more interesting of these finds in his Report.

At Karnak, a commencement has been made with the restoration of the Hall of Columns. All the fallen columns have been renewed, and a new foundation has been commenced. It is intended to proceed with this work very slowly and tentatively. It is under the very capable direction of Monsieur Legrain, who is specially charged with the work at Karnak. Several fine statues have been discovered during the progress of the excavation here.

By the end of 1901, preparation for the transfer of the collection from the Giza Museum, to the new building in Cairo, were well advanced. It is confidently expected that the transfer will be completed by August, 1902, and that the new building will be open to the Public at the beginning of next winter.

Good progress can also be recorded, regarding the new Museum Catalogue.

Two volumes (on Ostraca and on Metal Bases) have been published last year, and two others (Coptic Monuments and Objects Discovered by Monsieur Loret) are in an advanced state of progress.

Two others (Stone Vases and Stelæ of Middle Egypt) are in preparation, and will shortly be published, while the proofs of three more (Tombs of the Middle Empire, Stelæ Grœco-Roman and Votive Tablets) are at present under correction.

The staff, under Monsieur Maspero's direction, has done excellent work. The two Inspectors, Messrs Quibell and Howard Carter, have devoted themselves to their charges, and Messrs Brugsch Bey, Basile, Daressy, Barsanti, as well as the Egyptian Inspectors, deserve praise.

Lastly, the Gentlemen employed on the preparation of the catalogue, Messrs Von Bissing, Edgar and Lacon, have produced a very valuable season's work, in their important task.

V.—AGRICULTURAL RAILWAYS.

A report is attached on the working of these lines in 1901. Mr. Cotterill, who writes it, is the Chief Engineer of the Government Railways, but, at the same time, fills the post of Government Inspector of the Light Railways, for the Ministry of Public Works. His Report contains many interesting facts and shows that these lines are steadily winning their way to success, and overcoming the conservatism of the people, and the competition of the old methods of transport, viz., the camel and the donkey. They still, however, have a formidable rival in the shape of transport by boat. What they suffer from chiefly, is the shortness of the "leads" of the majority of their lines.

Notwithstanding this, the Delta lines can show good progress during last year, and their General Manager in Egypt, Captain Adams, has good reasons for satisfaction, when he reviews his last year's work. There is no doubt that these lines have met a great want and have rendered good service to the landowners in Egypt. When the system is more fully developed, these advantages will be more apparent.

Mr. Cotterill, at the end of his report, gives a striking instance of the way in which the introduction of a light railway line between the villages of Delingat and Damanhour, in the Province of Behera, has reduced the cost of transport of produce. There are many similar instances.

It is satisfactory to know that the opposition on the part of the peasantry, to the construction of these lines, which at first existed, has now almost completely disappeared. I may quote Mr. Cotterill again, to prove this. He says:— "In the Behera Province, the Headmen of "five small villages bought half a feddan of land from a poor villager "and gave it to the Company. When the station was opened, they "called it 'Ettehad,' which may be translated 'Unity' or 'alliance.'"

I think the above is a remarkable story, and one which proves that the Egyptian, once he has realised that an innovation is to his advantage, is quick, not only to accept it, but also to assist in its realisation.

There were at one time, four Light Railway Companies in Egypt. In the year 1899, two of these were amalgamated and there are now but three.

These are:—

(I) The Delta Light Railway Company, comprising the Provinces of Sharkia, Kaliubia and a portion of Dakahlia, with those of Gharbia and Behera.

(II) The Mansura-Mataria Light Railway Company, which serves the country between the two towns of that name.

(III) The Fayum Light Railway Company. This Company has the direction of the lines in the Fayum Province.

No. I is an English Company; No. II a Belgian; and No. III is purely Egyptian.

By the end of 1901, 1017·8 kilometers of line were open to traffic, in the three systems above-mentioned. There were 653·3 kilometres of telegraph and telephone line (belonging to the railways) open at the end of last year.

The Companies are gradually abolishing level-crossings, where their lines cross the State Railways. During last year, only four crossings were worked, two of which were merely used for passing rolling-stock across, at occasional intervals. The majority of crossings are now effected, either by subways, or by overhead-bridges.

In Table III, Mr. Cotterill gives figures showing the working expenses of the three systems and the ratio these bear to the gross receipts. They are :—

(I) Delta Company...	72·0	per cent.
(II) Mansura-Mataria Company	55·8	„
(III) Fayum Company	80·8	„

Of these, the Mansura-Mataria Company has been the longest in existence, but it seems probable that the ratio above given, nearly approaches the lowest, possible to reach. It is expected that the Delta Company will reduce its ratio during the current year. In the case of the Fayoum Company, many of the lines are now under construction, and the traffic has not reached its full development.

The average "lead" for passengers is only some 12 kilometres, while, for goods, it varies between 17 and 35 kilometres. These short "leads" are, as Mr. Cotterill says, fatal to economical working, or to high profits.

The passenger traffic on the Mansura-Mataria line, has increased by 25 per cent; in the Delta lines, it is the same as the year before, but in the Fayum, there has been a falling off.

Only one serious accident has been reported during last year. The engine was derailed and the driver killed.

Mr. Cotterill's tables show the following :—

LINES.	Length.	Number of passengers carried.	Average sum paid by each.
	Kilom.		Mills.
Delta Company...	735	2977787	20·3
Mansura-Mataria Company ...	109·8	587116	23·7
Fayum Company	120	385516	14·0

LINES UNDER CONSTRUCTION.

Delta Company	21	kilometres.
Fayum Company	39	„
Total... ...	60	„

Lines.	Receipts.	Gross Receipts.	Net Receipts.
	Total Expenditure.		
	£E.	£E.	£E.
Delta Company...	72033	99981	27948
Mansura-Mataria Company ...	11222	20079	8857
Fayum Company	8577	10610	2033

The annual net-receipts, per kilometre of line opened, show a remarkable difference.

They are:—

	£E.	
Delta Company	38	per kilometre
Mansura-Mataria...	80·5	„ „
Fayum	17	„ „

As I said before, the Mansura-Mataria Company has been longer in existence than either of the other two.

In conclusion, these lines promise to bring in a fair return upon the Capital expended and have, on the whole, good reason to be satisfied with the result of last year.

VI. — THE CENTRAL OFFICE.

(*a*) The staff.

Mr. Nicour Bey, the Secretary General, owing to continual ill-health, was unfortunately obliged to resign his appointment in the earlier half of last year.

His place has been taken by Monsieur Boinet Bey, formerly of the Finance Ministry. Mr. Boinet has most efficiently carried out the duties of the appointment, and has rendered me much assistance.

I have repeatedly, in former reports, recorded my sense of the valuable services rendered by Farid Bey Babazogli the "Chef du Service Administratif" of the Ministry of the Public Works. I have nothing to add to or to alter in, my remarks of former years, regarding this hard-worked and very excellent servant of the Government.

The large staff which he controls has, upon the whole, worked efficiently and well.

(*b*) Expenditure:

The following is the expenditure charged to this head in Table I of the Report.

	£E.	Mill.
Permanent Staff	27450	802
Temporary Staff	1878	253
General Expenses	5579	782
Material, furniture, etc.	98	624
New works	7664	590
Total...	£E.42672	·051

The last item, in the above, is distributed as follows:—

	£E.	Mill.
Cairo Opera House subvention and Staff	6059	000
Maintenance of above	499	000
Arab Monuments	996	250
Sundries	110	000
Total...	£E.7664	590

None of the above call for any special remarks.

W. E. GARSTIN,

Under Secretary of State
for Public Works Department.

Cairo, June 15th, 1902.

ADMINISTRATION REPORT

OF THE

IRRIGATION DEPARTMENT IN UPPER EGYPT

For 1901

BY

K. E. VERSCHOYLE,

INSPECTOR GENERAL OF IRRIGATION, UPPER EGYPT.

ADMINISTRATION REPORT FOR THE IRRIGATION DEPARTMENT IN UPPER EGYPT, 1901.

Part I.—IRRIGATION AND DRAINAGE.

SECTION I.—THE NILE.

At Aswan.

The year started with a level of 86·97 at Aswan which was 0·70 below the average for the thirty years ending 1892, but a great improvement on the record low level of 85·89 with which the year 1900 commenced. The rate of fall up to the 5th of May, when the minimum level was recorded, was normal. The minimum gauge-reading was 84·54, which is 0·47 below the average. The fall stopped twenty-one days before the average date. On reaching the minimum the level remained constant for five days, and then the rise proceeded at a satisfactory pace up to the 29th May, so that on the 1st June the level was only 0·14 below the normal.

The improvement, however, was not maintained, and there was a continuous fall from 29th May to 13th June, followed by a slow rise, so that on 1st July the level was 0·75 below the normal.

The rise during July was disappointing, and August began with a level of 1·28 below the normal.

The rise continued up to 20th August when a level of 92·80 or 16 cubits was reached. This is 0·10 below the normal. A slight fall now set in lasting till 30th August when the level was 92·35. Between the 30th of August and 6th September there was a satisfactory rise which brought the level on the latter date to 92·82. This second rise was followed by a very gentle fall up to the 20th September when the level was 92·55.

From the 20th September the fall was rapid and continuous till the end of the year, the level on the 31st December being 86·88 which is 0·79 below the normal and, with the exception of December 31st 1888 and 1899, is the lowest level on record for that date.

Summing up, the level was 0·70 below the normal during the summer, except from the middle of May to middle of June, during which period the early commencement of the rise caused a temporary improvement. The rise was early and at first satisfactory, but never became vigorous. The satisfactory feature of an otherwise feeble flood was the second rise between the 30th August and 6th September, and the slow fall from the latter date up to the 20th September, which was most opportune for basin irrigation.

At Asyut.

The following statement shews the average of the daily gauge-readings at the head of the Ibrahimiyah Canal during the summer months of 1900 and six typical years:—

YEAR.	AVERAGE GAUGE-READINGS AT ASYUT DURING				Nature of Summer Levels.
	April.	May.	June.	July.	
1899	46·50	45·91	45·47	46·52	High.
1885	45·52	45·13	44·87	47·25	Fair.
1883	45·57	45·19	45·03	45·77	Low.
1889	44·99	44·75	44·57	45·60	Very Low.
1892	45·24	44·77	44·58	45·55	do.
1900	44·89	44·88	45·17	46·19	do.
1901	45·03	45·15	45·42	46·69	—

The levels were slightly better than in the very low years of 1889 and 1900 but not as much as might have been expected, seeing that the Aswan gauge was steadily 0·50 higher for the four summer months than in 1900. The explanation of the discrepancy between the Aswan gauge, and the level at the head of the Ibrahimiyah, is to be found in the existence of the long, shallow channel along the west bank of the river connecting the canal head with the main stream, in which dredgers had to be kept at work till an advanced date. It was only towards the end of June, when the dredging had been completed, that the levels began to correspond to what was expected, seeing the levels which obtained at Aswan.

Owing to the interference with the river channel in the vicinity of the canal head by sadds above the Barrage, and the heavy cutting at the mouth of the diversion channel round the new head, the amount of silt carried down the canal was considerable, so that the higher gauge-readings, as compared with 1900, did not represent larger discharges. In fact the levels in the main canals below Deirut were slightly inferior to those of 1900, even though in the latter year there was an average cube of 350,000 M^3 escaped to the river at Deirut between the 20th May and 16th June.

The minimum gauge of 44·96 was recorded at Asyut on 11th of April. The true minimum should have occurred about the 13th May, but the intake channel had been improving between those dates, and the level at the head of the canal rising with the increased discharge. In future the interesting gauge for Middle Egypt at Asyut will be the canal gauge proper below the new regulating head.

The maximum gauge of 51·62 at Asyut occurred on the 21st September, the Upper Egypt basin discharges coming on the top of the slow fall following the minimum level of 6th September at Aswan. This level of 51·62 was 0·55 below the normal. It occurred at a favourable time for completing the irrigation of the east Ibrahimiyah chain of basins. There were the usual fluctuations in level up to 13th October, after which the fall became continuous.

Gauge at 1st Cataract.

The following statement gives the lowest and highest levels recorded above and below the 1st Cataract for the past five years. The Philæ gauge does not possess much value for purposes of comparison, and in future will be replaced by the Aswan Reservoir gauge.

The Aswan gauge will still continue to be the leading gauge of reference for Egypt north of that point.

YEAR.	MINIMUM GAUGE-READINGS.			MAXIMUM GAUGE-READINGS.		
	Philæ.	Aswan.	Difference.	Philæ.	Aswan.	Difference.
1897	90·56	85·62	4·94	97·95	92·80	5·15
1898	89·74	84·74	5·00	99·05	93·63	5·42
1899	90·70	85·15	5·55	97·00	91·67	5·33
1900	21·90	84·07	7·13	98·54	92·91	5·63
1901	90·90	84·54	6·36	99·07	92·82	6·25

River gauges south of Aswan.

The river-gauges south of Aswan, recorded last year were, on the White Nile, Gondokoro, Nassar (on the Sobat,) Tawfikieh, Fashoda, Duem; on the Blue Nile, Rosaries, Sennar, Wad Medani. At the junction of the Blue and White Niles comes the Khartoum gauge, and between that and Aswan, the Atbara, Berber and Halfa gauges. Duem, Rosaries, Khartoum, Berber and Halfa, are the only gauges out of the above list for which an unbroken record during the year was made. The following statement gives the maximum and minimum levels recorded on these five gauges for the past five years as far as records permit of:—

SITE OF GAUGE.	1897			1898			1899			1900			1901		
	Lowest.	Highest.	Difference.	Lowest.	Highest.	Difference.	Lowest.	Highest.	Difference.	Lowest.	Highest.	Difference.	Lowest.	Highest.	Difference.
Duem	—	—	—	—	—	—	—	—	—	—	—	—	0·27	4·30	4·03
Rosaries	—	—	—	—	—	—	—	—	—	—	—	—	1·29	8·12	9·41
Khartoum	—	—	—	—	—	—	0·46	5·59	5·13	0·26	6·49	6·75	0·08	6·10	6·18
Berber	—	—	—	—	—	—	—	—	—	0·41	7·67	7·26	0·63	7·87	7·24
Halfa	1·86	8·00	6·14	1·09	8·72	7·63	1·46	6·92	5·46	0·90	8·06	7·16	1·04	8·08	6·96

The readings of the Khartoum gauge in the above table previous to January, 1901, have been corrected by adding 0·22 to the readings previous to that date, to bring them into accordance with the existing gauge. The average maximum gauge at Halfa deduced from the records of the past eleven years is 8·39. The zero of the Halfa gauge appears to have been altered at the beginning of 1890, so the readings before and after that date do not admit of comparison.

SECTION II.—SUMMER IRRIGATION.

The volumes entering and utilized in the Ibrahimiyah Canal during the summer months of the last eight years, and the very low years of 1889 and 1892, are given below in cubic metres per second, together with the dates of complete closure of the Deirut Escape:—

YEAR.	APRIL.		MAY.		JUNE.		Date of complete closure of the Deirut Escape.
	Discharge at head.	Discharge utilized.	Discharge at head.	Discharge utilized.	Discharge at head.	Discharge utilized.	
1889	37·1	37·1	32·5	32·5	26·4	26·4	15th February.
1892	48·4	48·4	36·1	36·1	29·5	29·5	9th March.
1894	65·1	65·1	58·3	58·3	56·8	56·8	16th March.
1895	121·2	84·2	92·1	87·7	81·7	81·7	12th May.
1896	100·2	86·2	75·7	75·7	64·6	64·6	16th April.
1897	115·4	81·4	100·9	81·4	82·8	82·8	17th May.
1898	62·7	62·7	59·5	59·5	47·3	47·3	26th March.
1899	145·1	96·5	123·5	118·4	83·0	83·0	1st June.
1900	46·9	46·9	41·9 46·6	41·9 41·8	49·4 64·6	46·1 64·6	14th February. Re-opened 20th May. Re-closed 16th June.
1901	48·4	48·4	55·5	55·5	64·6	64·6	18th February.

Considering the supply in the river the discharges were low owing, as before explained, to the condition of the channel at the head.

No water was escaped at Deirut for the benefit of Lower Egypt as was done in the very low year of 1900. Rotations had to be commenced early, but worked without a hitch. The supply in the Fayum was somewhat light during April and May.

Fayum supply.

The usual rule was followed of giving the Bahr Yusuf at Deirut one-fourth of the discharge of the Ibrahimiyah Canal at Deirut plus 100,000 cubic metres. The lowest discharges of the Bahr Yusuf below Lahun recorded in each of four years of high and six years of low supply are as follows :—

YEAR.	DISCHARGE IN CUBIC METRES PER 24 HOURS.	
	High Years.	Low Years.
1901	—	18th May, 899,467
1900	—	16th June, 799,574
1899	25th June, 1,163,409	—
1898	—	2nd July, 1,033,124
1897	15th June, 2,298,067	—
1896	2nd July, 1,620,885	—
1895	1st July, 1,876,264	—
1894	—	900,987
1892	—	584,312
1891	—	645,400

The discharges during the summer months of 1898, 1899, 1900 and 1901 are as follows :—

1898		1899		1900		1901	
Date.	Discharge in c.m. per day.	Date.	Discharge in c.m. per day.	Date.	Discharge in c.m. per day.	Date.	Discharge in c.m. per day.
15th April ...	2,953,651	15th April.	4,228,456	1st April...	1,837,481	2nd April..	1,743,184
17th May ...	2,481,170	17th May..	2,970,259	16th April..	1,339,683	19th April..	1,188,386
12th June ...	1,560,325	16th June..	1,475,529	1st May....	1,235,699	2nd May...	1,205,245
2nd July. ...	1,033,124	25th June..	1,163,409	17th May..	1,418,866	18th May..	899,467
16th July ...	2,561,322	1st July ...	1,901,017	2nd June ..	1,085,937	1st June...	1,250,980
		17th July..	2,337,467	16th June..	799,574	16th June..	1,373,708
				1st July....	1,900,407	5th July...	1,421,772
				16th July..	2,027,959	18th July..	3,131,927

The average discharge may be taken as 1,205,245 cubic metres.

The area of summer crops in the Fayum, as given by the Chief Engineer, is 53,954 feddans. At 25 cubic metres per feddan per day this area would require 1,348,850 cubic metres, from which it appears that from middle of April to end of May the discharge was below requirements. The rotations, however, worked well, and complaints were rare.

Hassan Wassif Canal.

The new canal, christened the Hassan Wassif, taking out above Lahun to feed the Gharaq, Azab and Nezlah canals was completed during the year, and was utilized during the flood. In the flood of 1902 it is probable that a good deal of hitherto uncultivated land will be irrigated by the system of channels fed by this canal.

Rotations.

General rotations were commenced on the dates shewn in the following statement:—

PROVINCE.	CANAL.	Date of commencing Rotations.
Asyut	Sahiliyah	11th April.
Asyut	Deirutiyah	13th March.
Minia	Ibrahimiyah...	15th March.
Beni-Suef	Ibrahimiyah...	15th March.
Fayum	Bahr Yusuf and branches...	13th April.

There were three classes of rotations of increasing severity, as shewn in the following table:—

CLASS.	PERIOD OF ENFORCEMENT.	FREQUENCY OF WATERINGS.			
		Minia.	Beni Suef.	ASYUT.	
				Sahiliyah.	Deirutiyah.
I.	13th March to 29th April.	—	—	—	Once in 19 days.
„	11th April to 29th April.	—	—	Once in 16 days.	—
„	15th March to 28th March	Once in 19 days.	—	—	—
„	15th March to 8th April.	—	Once in 22 days.	—	—
II.	29th April to 18th July .	—	—	Once in 20 days.	Once in 20 days.
„	29th March to 2nd July.	Once in 22 days.	—	—	—
„	8th April to 19th June...	—	Once in 24 days.	—	—
III.	3rd July to 19th July ...	Once in 24 days.	—	—	—
„	19th June to 10th August	—	Once in 26 days.	—	—

The rotations commenced in the Fayum on 13th April and ended between 18th and 22nd July. As explained in last years' report the canals are divided into sections and periods of working allotted to each section proportionate to the area on it. The sum of the periods of working of the several sections of any canal amount to twelve days. One would say that this arrangement meant one watering in twelve days, but seeing that the duty at the head of the Province was only 24 cubic metres per feddan per day the waterings must have occurred at considerably longer intervals. The minimum watering of 350 cubic metres per feddan with a daily allowance of 24 cubic metres would take fifteen days, and the 24 cubic metres at the head has shrunk a good deal before it reaches the fields. Probably a good deal of the crop only gets a watering once in twenty-four days.

The usual rotations were enforced on lifting machines as follows:—

NAME OF CANAL.	Period of Rotation.	Nature of Rotation.
Ibrahimiyah Head to Deirut ...	10th April to 9th July	9 days working 9 days stoppage
Bahr Yusuf Head to Lahun ...	1st May to 15th June	5 „ „ 10 „ „
„ „ „ ...	15th June to 10th July	6 „ „ 12 „ „

The Cotton Crop.

The areas under cotton irrigated by the Ibrahimiyah Canal and its branches in the past six years are as follows:—

In 1896	75,134 feddans.
„ 1897	90,696 „
„ 1898	100,005 „
„ 1899	90,887 „
„ 1900	92,842 „
„ 1901	105,750 „

The following statement, kindly furnished by Mr. Wakeham, Agent of Messrs. Carver Brothers in Upper Egypt, shews the outturn of the ginning factories in the different provinces during the past nine seasons:—

PROVINCE.	OUTTURN IN KANTARS.								
	1893-94	1894-95	1895-96	1896-97	1897-98	1898-99	1899-900	1900-01	1901-02
Beni Suef ...	85,000	120,000	150,000	154,000	178,000	143,000	139,000	131,000	174,000
Minia	30,000	50.000	82,000	107,000	125,000	74,000	105,000	104,000	128,000
Fayum	75,000	90,000	130,000	138,000	163,000	137,000	170,000	130,000	130,000
Totals ...	190,000	260,000	362,000	399,000	466,000	354,000	414,000	365,000	432,000
Average price per kantar...	P.T.210	P.T.165	P.T.205	P.T.205	P.T.162	P.T.156	P.T.205	P.T.275	P.T.205

The following statement gives the area in feddans of cotton irrigated from the Ibrahimiyah Canal in the different provinces during the past four years:—

YEAR.	Assyut.	Minia.	Beni Suef.	Fayum.	TOTAL.
1898	2,635	19,580	26,253	51,537	100,005
1899	1,874	20,576	22,277	46,160	90,887
1900	2,753	27,912	26,086	36,091	92,842
1901	3,361	26,599	28,177	47,643	105,750

From the above it will be seen that the area exceeded that of the bumper year of 1898 by 5,745 feddans. The Fayum, which in 1900 restricted its sowing owing to fear of short supply, got back to its normal area. The outturn of 4·08 kantars per feddan agrees closely with the average of 4·0 kantars of the three previous years. Taking the four years in the list we find that the outturn in 1898 was 3·54 kantars and in 1899 4·55 kantars per feddan.

Sugar-cane.

The following statement gives the quantities of cane crushed in the chief factories in Upper Egypt, and the outturn of No. 1 sugar during the past four seasons:—

FACTORIES.	SEASON 1898-99			SEASON 1899-00			SEASON 1900-01			SEASON 1901-02		
	Cane crushed	Outturn No. 1 Sugar	Percentage	Cane crushed	Outturn No. 1 Sugar	Percentage	Cane crushed	Outturn No. 1 Sugar	Percentage	Cane crushed	Outturn No. 1 Sugar	Percentage
	Kantars	Kantars		Kantars	Kantars		Kantars	Kantars		Kantars	Kantars	
Daira Sanieh ..	13,680,944	1,253,525	9·2	14,515,565	1,369,953	9·4	11,850,485	1,161,471	9·08	12,442,452	1,245,843	10·01
Daira Sultan Pasha	479,822	43,885	9·1	466,027	42,059	9·2	524,466	49,469	9·04	*410,465	40,230	9·75
Société Générale des Sucreries de la Haute-Egypte	6,250,320	604,002	9·6	5,978,871	575,409	9·6	6,908,772	682,587	9·88	7,653,548	642,813	8·40
Egyptian Sugar & Land Company.	546,355	49,338	9·8	504,336	46,608	9·2	850,500	84,810	9·06	—	—	—
Beni Korrah. ..	—	—	—	504,337	46,608	9·2	—	—	—	—	—	—
TOTAL KANTARS..	20,957,441	1,950,750	9·3	21,969,136	2,080,637	9·4	20,134,223	1,975,337	9·08	20,506,465	1,928,886	

The Egyptian Sugar & Land Coy. did not work its factory during the season, and sent all the cane raised on its pumping station to the "Société Générale des Sucreries," which has taken a lease of the

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* 54,547 kantars were crushed for molasses.

company's property. The small factory of Beni Korrah also did not work for the second year in succession, finding it could not do so at a profit.

The following statement gives the areas under sugar-cane irrigated from the Ibrahimiyah Canal in the different provinces during the last four years, and the area raised south of Asyut irrigated by river pumps and wells:—

YEAR.	Asyut.	Minia.	Beni Suef.	Fayum.	Total.	South of Asyut.	Grand Total.
1898	9,883	35,232	5,383	854	51,352	—	—
1899	9,473	33,829	7,082	677	51,061	—	—
1900	8,052	22,139	5,670	458	36,319	17,440	53,759
1901	12,780	28,413	6,282	618	48,093	14,522	62,615

A big cotton crop means a small sugar crop, so the area under the latter crop is ruled by the price of cotton. Taking the four years included in the above statement we find that the aggregate area under sugar and cotton exceeded that of 1898, the next best year, by 2400 feddans.

As 1898 was a bumper year, it appears that the area under these, the two principal sefi crops$_2$ is increasing in spite of the low summer water-supplies.

Sorghum or Summer Durah.

The following statement gives the areas of summer durah or "Qedi" grown in the basins of the different provinces during the last three years:—

YEAR.	AREAS IN FEDDANS IN THE DIFFERENT PROVINCES.							Total Area
	Aswan.	Kena.	Girga.	Asyut South.	Asyut North.	Minia.	Beni Suef.	
1899	3,195	23,334	29,984	10,150	8,572	5,459	7,072	87,766
1900	2,972	24,258	39,261	12,389	7,701	3,890	6,076	96,547
1901	2,482	21,526	41,433	10,334	7,850	4,734	8,734	97,093

The "Qedi" crop was a good one, The shrinkage in Aswan and Keneh is probably due to the big demand for labour during the summer, due to the extensive Irrigation Works in Upper Egypt.

Maize and Winter Crops.

The Nabari area in the southern provinces is estimated at 146,278 feddans. The estimates for 1899 and 1900 were 155,000 feddans and

131,337 feddans respectively. Besides Nabari Keneh Province had a Nili melon crop of 13,644 feddans. The Nabari crop was a good one and the winter crops promise well.

Duty of water. The total area of summer crops irrigated by the Ibrahimiyah Canal, according to the figures furnished by the Chief Engineers, is as follows :—

In the Asyut Province	34,657	feddans
„ Minia Province	67,529	„
„ Beni Suef Province	36,623	„
„ Fayum Province...	53,954	„
Total	182,763	feddans

The mean discharge for the three summer months April to June, at the head of the Ibrahimiyah Canal, may be taken as 5,424,068 cubic metres, which is the mean of the seven discharges observed during that period. On the area of summer crops given above, this discharge gives a duty of 29·6 cubic metres per feddan per day.

The mean and minimum discharges recorded during the year in the Ibrahimiyah Canal and Bahr Yusef are as follows :—

CANAL.	Site.	Mean discharge April to June.	Lowest recorded discharge.
Ibrahimiyah ... ... (1)	Above Deirut... ...	4,843,213	4,062,528
— (2)	Below Deirut... ...	2,756,160	2,312,064
— (3)	„ Maghagha ...	684,732	627,264
Bahr Yusuf ... ... (4)	„ Lahun... ...	1,297,536	899,467
Ibrahimiyah	Minia Province (2) (3)	2,071,428	1,684,800

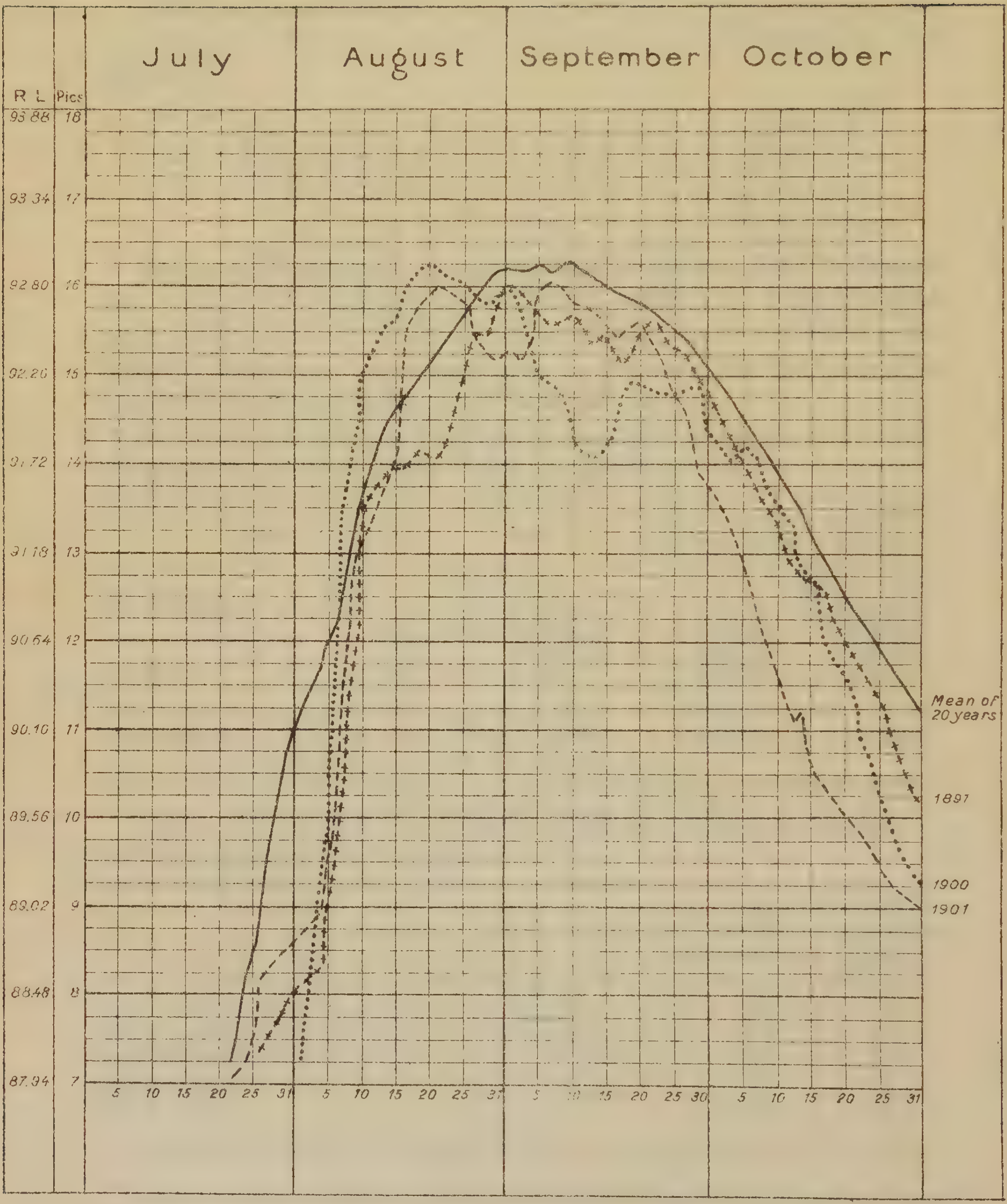
Taking the areas in the different provinces we obtain the duty of water in each group as follows :—

PROVINCE.	Duty on mean discharge.	Duty on minimum recorded discharge.
	C. M.	C. M.
Assyut, Minia, Beni Suef and Fayum together.	26·5	22·2
Minia and Beni Suef together	26·4	22·2
Beni Suef alone	23·6	21·6
Fayum alone	24·0	16·6
Minia alone	30·0	24·9

In the above statement, using the Chief Engineer's figure for the area of Sefi crop in Beni Suef, we get duties of 18·7 on the mean, and

PLATE V

GAUGE AT ASWAN



Survey Dept. P.W.M.

17·1 on the minimum discharge, which are manifestly absurd. The figure furnished by the Ministry of Finance for the total Sefi area in Beni Suef Province is 39,196 feddans. Deducting 8,734 feddans, the area of Qedi in the basins, we get 30,462 feddans, and allowing for the area irrigated directly from the river we arrive at a figure of 29,000 feddans as approximately the correct area of Sefi irrigated from the Ibrahimiyah in Beni Suef Province, and this is the figure I have adopted in the above statement. Proceeding in exactly the same way for Minia Province we arrive at a figure of 67,000 feddans as the Sefi area on the Ibrahimiyah, which agrees closely with the Chief Engineer's figure. Obviously the above correction will affect some of the other figures given for duties, but so slightly as to be immaterial. I attach no value to the duty calculated on the minimum discharge, which is only recorded because it has been customary to do so.

SECTION III.—FLOOD IRRIGATION.

General character of the flood.

The accompanying diagram shews the Aswan flood gauges for 1901, 1900, 1897—a year of very similar flood—and the mean of twenty years ending 1892.

The following statement compares the maximum and mean flood gauges at Aswan for 1897, 1900 and 1901 :—

ASWAN GAUGE-READINGS.	1897		1900		1901	
	Gauge-Reading.	Date.	Gauge-Reading.	Date.	Gauge-Reading.	Date.
	P. K.		P. K.		P. K.	
Maximum reading..	16 0	Aug. 31st	16 15	Aug. 19th	16 0 16 1	20th & 21st Aug. 6th & 7th Sept.
Mean for 40 days ending 24th Sept.	15 6	—	15 7	—	15 14	—
Mean for irrigation south of Sohag, 11th August to 14th October ...	15 1	—	15 3	—	14 15	—
Mean for irrigation north of Sohag, 10th August to 20th October ...	14 18	—	14 9	—	14 6	—

Up to the end of August the levels were intermediate between those of 1897 and 1900. From 1st to 24th September the levels were almost identical with those of 1897 and considerably better than those of 1900. From 24th September the 1901 levels fell away rapidly as compared with either those of 1897 or 1900.

Summing up, we may say that the flood was below the average, distinctly better than that of 1900, and about the same as that of 1897.

Filling basins.

In the 5th Circle.—The following statement shews the dates on which water entered the Aswan isolated basins and the two southern basins of the Ramadi system, the amounts by which the levels reached in each basin fell short of T.R. level, and the resultant "Sharaki" area during the past two years. According to the Inspector of Irrigation, 5th Circle, a level of 18 cubits at Aswan is required to completely fill these basins :—

NAME OF BASIN.	Date on which water entered basin.	Amount by which maximum level fell short of T.R.L.	Sharaki area, 1901.	Sharaki area, 1900.
Hod El Khattara ...	8th to 16th August.	1·05	1,039 feddans.	2,060 feddans.
„ Daraw		0·84		
„ Eglit		1·27		
„ Bimban		0·67		
„ Ramadi South ...		1·03		
„ Ramadi North ...		0·40		
„ El Redisiyah ...		0·58		
„ Silwa		0·70		

The accuracy of the figures for "Sharaki" areas cannot be vouched for. One would have expected about the same area as in 1900. The area of "Sharaki" is often reduced by putting the high lands under Nabari. The figures are, however, useful as shewing approximately how these southern basins fare in years of feeble flood.

Water entered the main feeder canals between the 26th July and 16th August. Most of the canals were running by 6th August for the benefit of Nabari and sugar crops.

The Shanhariyah, Ghilassi and Samata canals were opened last between 10th and 16th August. The basin feeders were all opened between the 10th and 18th August. The last basin to take water was Hod Esna North. The dates of opening the feeders were regulated by the completion of the harvesting of the "Qedi" durah. T.R. levels were reached between 13th September and 13th October. The basins of the Bayadiyah system, and the southern basins of the Ghilassi system were the latest.

The following points in connection with regulation are worthy of record.

The Kilh Regulator on the Ramadi Canal was partially closed from the 28th August to 4th September, and a cut was made in the left bank of the canal to hasten the filling of Hod Edfu. The Meammariyah Regulator on the same canal was closed between 19th and 23rd September to fill Hod Sibaiyah. El-Deir Regulator, at kilometre 21 of the Killabiyah Canal, was partially closed between 29th August to 14th September to get the highest level possible in Hod Hillah Der. The maximum level it was possible to attain in this basin was 80·67, which is 0·50 below T.R. level. As the high lands in the basin had been for the most part sown with a Nabari crop the "Sharaki" area was unimportant. There was also a small area of "Sharaki" in the Qift east basin of the Shanhuriyah system.

The Qariyah and Demigrat regulators, on the Ramadi and Assfun canals respectively, were worked alternately in the interest of the dependent basins, and the sugar crops in the Mataâna and Armant Teftiches of the Daira Sanieh. In the northern basins of the Sahel Farshut system alone it was found possible to change the water by "Takhfifing" from the 20th September.

Regulation between the 5th Circle and Girga.

The Samhud Salibah regulators remained closed from the commencement of the flood till the 25th September when they were opened till 1st October for "takhfif" of Samhud basin.

In Girga Directorate.—The main canals were generally opened on the 12th August. The Rashwaniyah, Sohagiyah and Shatturah canals were opened on the 12th August. The Hawis and Awlad Yehya canals were opened on the 13th and 30th August respectively. A red water supply was drawn through the following escapes:—

Haanan Escape Khiyan system	from	11th to 12th	August.
Gezireh Khalafiyah North Sohag system	,,	26th to 30th	,,
Hoshah Magris North Sohag system ...	,,	20th to 21st	,,
Abu Tig North Sohag system	,,	10th to 18th	,,
Matia North Sohag system	,,	10th to 27th	,,
Shatb North Sohag system	,,	10th to 24th	,,
Selim North Sohag system	,,	10th to 19th	,,
Qaw Khizindariyah system	,,	10th to 14th	,,
Hoshah Tawabiyah, Abnoub system ...	,,	16th to 25th	,,
Masah Abnub, Abnub system	,,	10th to 11th	,,
Maabdah Abnub system	,,	10th to 12th	,,

Levels did not admit of the other escapes being used as feeders.

T.R. levels were reached generally between 15th and 25th September. A few basins had reached T.R. levels by 1st September. The latest basin, that of Beni Smià West, was filled by 2nd October. The time occupied in filling basins varied from nine to fifty-two days. The mean time was forty-two days.

The following are the points in connection with the working of regulators which may be usefully recorded:—

In the Khiyam system, Khiyam Regulator, kilometre 37 of Tarif Canal, was partially closed from 30th August to 8th September to fill Khiyam Basin, the maximum level attained upstream bring 66·67. The Sheikh Mobadir Regulator, kilometre 24 of the same canal, was partially closed from the 10th to 30th September to fill Balabish Basin, the maximum level attained upstream being 67·19. The Khiyam Sahel was irrigated by holding up the level above Kush Regulator, kilometre 32, Tarif Canal, to R.L. 67·18. The level above Mazata Regulator was held up to 65·90 to fill Mazata Basin.

In the Akhmim system the level above Abbas Regulator, kilometre 35, Lahaywa Canal, was raised from 16th August to 19th September to fill Akhmim Basin. The level attained upstream of the regulator was 61·97. The level above Isawiyah Syphon, kilometre 17, Lahaywa Canal, was raised from 13th to 17th September for irrigation of the adjacent sahels, the maximum level attained being 62·78. Akhmim Regulator, kilometre 20 of the same canal, was worked with the same object from 17th to 19th September, the maximum level attained being 62·53.

In the South Sohag system the level above Bindar Regulator, kilometre 31, Zarzuriyah Canal, was raised from 28th August to 23rd September to fill the following basins Araba, east and west, Sahel Tuk, Akaywa Kharifa, Bagiyah Bawarik and Geziret Muntassir. The maximum level attained upstream of the regulator was 64·00. The maximum level permitted upstream of the Sohagiyah Syphon, Girgawiyah Canal, was 62·15.

In the North Sohag system the level upstream of Nag Tammam Regulator, kilometre 44, Girgawiyah Canal, was raised from 9th to 29th September to fill Awlad Nasser, Morfin, Sahil Qilfaw, Baga, and Nag Tammam basins. The maximum level attained upstream of the regulator was 61·20. During the same time, by closing the feeder culverts above the regulator for a few days, a level of 61·49 was produced upstream of the Qilfaw Regulator on the canal of the same name, which completely irrigated the high lands of Sahils Qilfaw and Baga. Hod Kom Badî West was brought up to T.R. level by closing the head regulators of Harafsha, Beni Harb and Soffeha canals, and letting Enebis Escape go. A level of 58·39 was thus obtained upstream of Kom Badr Canal Head. Next year the Talihat Regulator will be available for filling this and the adjacent basins. The effect of the alterations to the Shatturah Syphon, carried out during the summer, greatly lessened the time occupied in filling the basins dependent on the Qaw Canal which all reached T.R. level before the 20th September.

In the South Asyut system the Tissâ regulators, in Saliba Beni Smiâ, was partially closed from 31st August to the end of the season. The maximum level attained upstream was 55·42. Orders have recently been issued that this regulator should remain fully open till Hod Zannar is within 30 centimetres of T.R. level, so that a sufficient discharge may pass Djebel Asyut Regulator for filling the next Ibrahimiyah chain of basins.

In the Khizindariyah system the level upstream of Hassan Regulator, kilometre 28, Khizindariyah Canal, was partially closed from 15th September to fill Badari East and Sahel basins, the maximum level attained being 55·68.

The irrigation of the Abnub system calls for no remarks.

Regulation between Girga Directorate and 4th Circle.

The Djebel Asyut Regulator was kept fully open from the beginning of the flood till the 12th September, when regulation on it commenced and continued up to the 8th October, on which date the regulator was closed for "sarf." On the 29th October the regulator was opened again to let the low portions of Hod Zannar drain into Hod Mallah.

In the 4th Circle.—Water passed Djebel Asyut bridge on 11th August, and all basin feeders were opened by 18th August. In Minia Province all feeders taking directly from the river were opened by 15th August. Water was admitted to the west of Yusufi basins on the 15th August, and the feeders were all fully open by the 20th August. In Beni Suef Province all the basin feeders taking off from the river were working by the 12th August. The opening of Nuera Canal, taking off from the Ibrahimiya, was delayed till the 25th August, owing to the delay in closure of the diversion channel round the new Hafiz Regulator, and consequent delay in passing full supply down the Ibrahimiyah.

The following statement shows the dates on which the several systems reached their T.R. levels :—

NAME OF SYSTEM.	Date on which T.R.L. was reached.	REMARKS.
Asyut-Delgawi	30th Sept. to 13th Oct.	Hod Maharraq was "takhfifed" from 10th Sept. and Hoshah Delgawi from 24th September.
East Ibrahimiyah, Asyut to Deirut.	18th Sept. to 26th Sept.	Except Hods Masarah & Mandara filled during "sarf" by middle of October.
Sabakhah	10th Oct. to 13th Oct.	Hods Quran and Tahawi were "takhfifed" from early in Sept. Hod Tahnashawi only reached T.R.L. on 31st Oct.
Etsa...	17th Oct. to 23rd Oct.	Etsa Canal was closed on 29th Sept. and the Hods were brought up to T.R.L. during "sarf."
Abu Bagara	27th Oct. to 28th Oct.	All the Hods were "takhfifed" during September.
West of Yusufio suth system.	10th Oct. to 22nd Oct.	During "sarf."
West of Yusufi, north system.	13th Oct. to 24th Oct.	All the basins were "takhfifed" from end of September.
Beni Suef	29th Oct. to 3rd Nov.	Brought up to T.R.L. during "sarf."

The conversion into perennial tracts of the Asyut basins north of Deirut, the completion of the basin systems, west of the Yusufi, and of the three new regulators in the Yusufi introduced several novel features into the procedure followed during the filling of the basins which may be usefully recorded here.

The Itqa Canal, closed owing to the conversion of Itqa Basin, was replaced by a cut in the Yusufi Tarrad at the south-west corner of Hod Tanashawi. Regulation on Naglet-El-Abid Regulator, the most southerly of the three new Yusufi regulators, was commenced on the 15th August with an upstream level of 39·10 and a downstream level of 38·78. By the 3rd September the upstream level had risen to 40·00, the downstream level being then 38·92. The filling of the southern chain of basins proceeded slowly, the basins being long, and there being only one feeder-head of three vents upstream of the regulator. The feeder-heads in the Tarrad downstream of the regulator did not render much assistance, as a sufficient level could not be maintained below the regulator to make them work, till the sowing of the flood crops in the Fayum Province had been completed. During the past season a breach in the Nazlet-El-Abid Salibah assisted the filling. To improve the irrigation of this chain of basins it will be necessary to increase the water-way of the Zawiet Hatem head sluice above the Nazlet-El-Abid Regulator, and begin severe regulation on the latter at an earlier date in future; this means increasing the water-way of the most contracted reach of the Yusufi, which it is proposed to do during 1902.

To fill the northern chain of the West Yusufi basins regulation on Saqula Regulator commenced on the 30th August with an upstream level of 32·53 and a downstream level of 31·90. By the 19th September the upstream level had increased to 33·80, the downstream level being then 30·38. This chain filled easily and quickly. Mazurah Regulator, the third and most northerly of the new Yusufi regulators, was regulated on from the 25th September to increase the supply entering Hod Sultani.

Regulation between 4th and 3rd Circles.

The existing rule regarding regulation on Komi Bridge in Salibah Riqqah, the boundary of the two circles, runs as follows:—

"From 10th August Komi Bridge and the regulators on Saliba Qosheshah are to be kept open as long as Qosheshah Escape is open, and drawing from the river. If, however, it is found that water from Komi is flowing back into the river through Girza Head, then Komi should be closed and only re-opened when water ceases to flow into the river. As soon as a commencement is made with the closure of Qosheshah Escape, Komi should be closed also, and regulation should be made on the bridges in Qosheshah Saliba so as to raise water in Hods Riqqah and Qosheshah at an equal rate till they reach T.R. levels. As soon as the nature of the flood shows that there is no difficulty in filling the Riqqah and Qosheshah basins Komi Bridge can be opened again according to the requirements of the Gizeh basins."

In accordance with the above rule Komi was closed on the 27th August, and was re-opened gradually from the 25th October. Hod Qosheshah reached T.R. level on 3rd November.

Lower Egypt complained of the excessive discharge passed through Komi. The Acting Inspector General stated that he estimated the discharge passing on the 4th September at 8,000,000 cubic metres per day and on the 11th October at 4 to 5,000,000 cubic metres per day, which discharges he considered were doing damage by checking the flow of red water through Girga Head. As all the bays of the regulator were full of planks from the 27th August, there being no object in passing on water seeing that Qosheshah and Riqqah basins were much below T.R. level, till the very end of the season, I think there must have been some radical error in the calculation of these discharges. The regulator would have to be at least half open to pass a discharge of 8,000,000 cubic metres per day. I do not think leakage through the planks could represent more than 2,000,000 cubic metres. To estimate a discharge without knowing the water-way is not a simple matter.

Discharge of basins.

In the 5th Circle.—The following statement gives the dates of commencement and completion of "Sarf" operations in the different systems:—

NAME OF SYSTEM.	Sarf operations commenced.	Sarf operations completed.
Ramadi	4th to 12th October.	21st to 31st October.
Asfun	1st to 8th October.	31st Oct. to 1st Nov.
Fadiliyah...	5th to 16th October.	16th Oct. to 3rd Nov.
Sahil Farshut...	10th to 15th October.	20th Oct. to 1st Nov.
Killabyah	7th to 8th October.	23rd to 31st October.
Bayyadiyah	3rd to 13th October.	12th to 21st October.
Shanhuriyah	13th to 19th October.	17th to 31st October.
Ghilassi	12th to 19th October.	19th Oct. to 4th Nov.

Water had to be passed from basin to basin in the Ramadi system to bring them up to T.R.L. Hods Qamula, Rayyayna, and Ekhmas, Fadiliyah system, were brought to T.R.L. by passing on water from Hod Dabiyah, the tail basin of the Assfun system. The river-level was very low, but the "Sarf" passed off without incident.

In the Girga Directorate.—The following statement gives the dates of commencement and completion of "Sarf" in the various systems, and the dates of opening the Nile Escapes.

NAME OF SYSTEM	Date of commencement of Sarf.	Date of completion of Sarf.	Dates on which Nile Escapes were opened
Khiyam System...	5th to 13th October.	22nd to 27th October.	21st to 28th Oct.
Akhmin	5th to 13th October.	19th to 24th October.	18th Oct.
Khizindariyah ...	5th to 14th October.	13th to 26th October.	15th to 21st Oct.
Abnub	5th to 14th October.	18th to 28th October.	19th to 22nd Oct.
South Sohag. ...	5th to 22nd October.	19th to 1st Nov.	22nd to 23rd Oct.
North Sohag. ...	5th to 18th October.	19th to 25th October.	19th Oct.
South Asyut. ...	5th to 15th October.	25th to 28th October.	—

The average time occupied in filling 100 basins was thirty-eight days, and average time occupied in discharging the same basins was thirteen days.

In the 4th Circle.—The dates of commencement and completion of "Sarf" in the various systems was as follows:—

NAME OF SYSTEM.	Safr commenced.	Sarf ended	REMARKS.
East Ibrahimiyah, Asyut to Deirut.	1st Oct.	End of Oct.	These basins began falling of their own accord as the river was too low to keep them up.
Asyut-Delgawi Chain ...	8th Oct.	End of Oct.	Except Hod Delgawi, which was not completely sarfed till 10th November.
East of Yusufi basins, Minia Province.	13th Oct.	9th Nov.	Tanashawi, the head basin, was completely sarfed by 30th October.
West of Yusufi basins, Minia Province.	15th Oct.	10th Nov.	—
Beni Suef basins	29th Oct.	17th Nov.	Hod Qosheshah completed 19th November.

Owing to the completion of the basins west of the Yusufi, and the consequent contraction of the flood section of that channel the escapes discharging on to it had to be worked with much greater caution than usual to avoid a dangerously high level, which would have damaged the villages on the banks; and at the same time produce a level high enough to irrigate the sahels. In particular, severe pressure was experienced in the Yusufi south of the Itqa Canal Head which channel used to draw off a large discharge, but was closed during the past flood owing to the conversion of Itqa basin into a "Sefi" tract. For this reason the level in the Yusufi below Delgawi Escape had to be kept lower than in past years, and the "Sarf" was consequently delayed.

Appendix L gives the dates of the principal events of "Sarf" in the 4th Circle during 1897, 1898, 1898, 1900, 1901 The exceptional year of 1899 is not included.

For the reasons given above the "Sarf" operations were more complicated than usual, and I extract the following remarks from Mr. Clowes' interesting report on the subject.

In the Asyut Delgawi system the Gebel Asyut Bridge was closed on the 8th October, and the basins takhfifed northwards from that date. A flush was sent down the Yusufi between the 6th and 9th October to flood the sahels down to Delgawi. Delgawi and Badrawan escapes were opened gradually between 10th October and 1st November, and the discharge through them and the Beni Khalid Escape sufficed to flood the Yusufi sahels down to Nezlet El Abid Regulator.

We next come to the east and west chains of basins north of Nezlet El Abid. The head of the chain on the east is Hod Tanashawi and on the west Hod Tukh. These two basins were brought up to T.R.L. on 13th October. On the 14th October Nezlet El Abid Regulator was fully opened, and the escapes of Hod Tanashawi and Tukh let go. The level thus obtained flooded the Yusufi sahels down to Hod Tahawi Hod Qurun (basin No. 2 on the east) reached T.R.L. on 10th October and was "Sarfed" on to Hod Tahawi (No. 3). Hod Tahawi was "Sarfed" on to Hod Deri (No. 4) on 13th October. To increase the level in the Yusufi a cut was made in the tarrad of Hod Tahawi on 14th October, the date on which Nezlet El Abid Regulator was opened. Hod Tukh was "Sarfed" on to Hod Qamadir (No. 2 basin west chain) on 14th October and the latter on to Hod Shushah (No. 3) on 16th October. Hods Shushah and Deri reached T. R. L. on 17th October. A cut was then made in the tarrad of Hod Deri to raise the level in the Yusufi, and at the same time Hods Shushah and Deri were "Sarfed" on to Hods Tirfa and Menqatin, the next northern basins in the west and east chains respectively. Hod Tirfa reached T.R.L. on 18th October, and was then "Sarfed" on to the Yusufi and also on to Hod Der, the most northern basin in the southern system west of the Yusufi. The level however at Saqula was still not sufficient to flood the sahels. On the 20th October Hod El Der had nearly reached T.R.L. and its escape on to the Yusufi was partially opened.

On the following day Saqulah Regulator was fully opened. A slight mistake was made here in opening El Der Escape too much, and the consequence was that the level at Saqulah exceeded T.R.L. by 16 cents on 21st October and remained too high till the 24th October. The discharge of El Der Escape and the Salibah bridges to the south were checked, and though the tarrads were nearly topped in some places no harm resulted.

In the eastern chain Hod Menqatin (No. 4) reached T.R.L. on 20th October and was "Sarfed" on to Hod Membal (No. 5) the following day. Hod Membal reached T.R.L. on 23rd October, and was "Sarfed" on to Hod Bardanuha (No. 6) on 25th October. Hod Bardanuha reached T.R.L. on 27th October and water was passed on from it to Hods Garnusi and Salaqusi which reached T.R.L. on 28th October, on which date the tail escape of the Tanashawi-Salaqusi chain Abu-Raheb was opened.

The wave from Saqula reached Bortobat, the southern basin of the northern system of the West Yusufi basins, on 21st October, but this chain being already full could not relieve the pressure in the Yusufi between the 21st October and 24th October, referred to above. Mr. Clowes remarks that in future it must be so arranged that this northern system is takhfifing heavily by the time the wave comes down the Yusufi.

Regulation on the new Mazurah Regulator was commenced on 16th October for the benefit of the Beni Suef basins. The wave reached the regulator on the 17th October and attained its maximum height on 1st November. The regulator was fully opened by 27th October. The Yusufi Sahils north of Mazurah were successfully flooded.

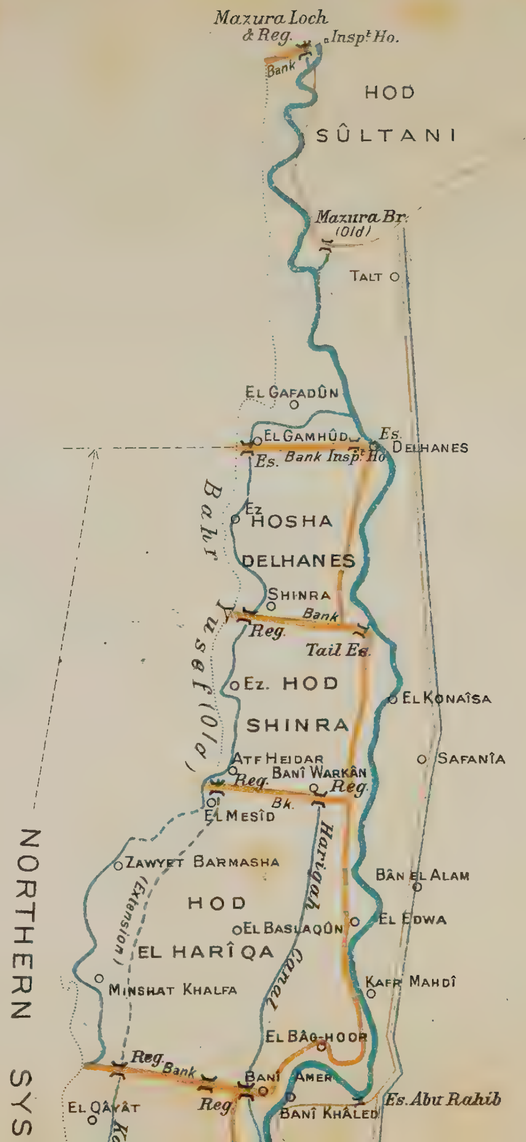
On the 5th November forty of the upper gates of Kosheshah Escape were let go, and the rest were gradually dropped up to the 8th November. The lower gates were opened gradually between the 10th and 23rd November.

The experience of the past flood has shown that, owing to the conversion of the East Yusufi basins, which are no longer available to pass part of the Yusufi flood-supply through, and the creation of the West Yusufi basin systems on an area which was formerly flooded only during "Sarf," the demand for water in the Yusufi, during August and September, has been increased, while the flood-section has been diminished. In fact the Yusufi gauge at Deirut had to be kept 0·40 lower than in previous years. The most contracted section of the channel lies between the head of the abandoned Itqa Canal and the tail of the Asyut-Delgawi chain of basins, below which point there is a wide strip

PLATE IV.

BAHR YUSEF
MINIA PROVINCE
SHOWING
NEW WEST BASINS.

SCALE = 1 : 200,000



of Sahil on the left bank extending to Nezlet-El-Abid, which serves to relieve the channel. To improve the carrying power of the Yusufi at this point it is proposed to make a canal through Hod Beni Khalid, the tail basin of the Asyut-Delgawi chain, to replace the Itqa Canal.

The accompanying plan of the basins along the Yusufi illustrates the above description of "Sarf" operations.

Accidents during flood.

There were a few small breaches in the Girga Directorate and the 4th Circle, but none of them was important or caused any damage.

New Works shewn to be necessary during recent flood seasons.

In last year's report was given a list of works for improvement of flood irrigation in the several circles. The list included thirty-four works for the 5th Circle, twenty-four works for Girga Directorate and two works for the 4th Circle. The small number for the 4th Circle is explained by the fact of the extensive improvements being carried out in that Circle under the head of "Special Works." The following is a revised list containing sundry additional works. A separate series is given for each Circle or Directorate. Interruptions in the series show that the works corresponding to the numbers omitted have been constructed. Thus we see that in Girga Directorate the works corresponding to the numbers 1, 2, 11, 13, 19, 20, 21, 24 were executed in 1901. In 5th Circle 33 kilometres of new sayalahs, three feeder culverts and one escape, not included in last year's list, were made during the year. In the 4th Circle the pipes required for items 1 and 2 were procured and the work will be carried out in 1902.

Serial Number.	Circle.	Province or System.	DESCRIPTION OF WORK.
1	5th Circle	Aswan	Lowering bed of Debeirah Canal 0·50.
2	,,	,, ...	Making a new canal at Eneiba, Korosko.
3	,,	,, ...	Lowering beds of Sayalahs El Khattarah, Eglit Daraw, Bimban to 10 cubits.
4	,,	,, ...	New sayalah for Ghezirct Baharif.
5	,,	,, ...	New Faris Canal south of Shellal.
6	,,	Ramadi system ...	Prolongation of Sayalah Sahel El Ramadi to Sahel Edfu.
7	,,	,, ,, ...	Prolongation of Sayalah Hod El Bassaliya West to Hod El Sibaiyah.
8	,,	,, ,, ...	New regulator for above in Salibah Basaliyah.
9	,,	,, ,, ...	Regulator in Salibah Hod Edfu and remaking old Sayalah through Hod El Bassaliyah.

Serial Number.	Circle.	Province or System.	DESCRIPTION OF WORK.
10	5th Circle	Ramadi system ...	Prolongation of Sayyalah El Adayma Hod El Namasa to join Sayalah Kommer.
11	,,	,, ,, ...	Prolongation of Sayalet Sahel El Adayma to join Sayalah Sahel El Namasa and prolongation of the latter to join Sayalah El Ghoreirah.
12	,,	,, ,, ...	Head regulator for Sayalah El Namasa.
13	,,	,, ,, ...	,, ,, ,, El Ghoreira.
14	,,	,, ,, ...	Widening Sayalah El Ghoreirah to 3 metres
15	,,	,, ,, ...	Prolongation of Sayalah Hod Esna South to Saliba.
16	,,	,, ,, ...	Prolongation of Sayalah Sahil Esna to the "Mawati" and the new escape.
18	,,	Asfun ,, ...	Canal along west of Asfun Canal from "Mawati" of Hod El Kiman to join Sayalah Hod El Mahamid, and thus connect Ramadi and Asfun systems.
19	,,	Killabiya ,, ...	Bank round southern portion of Sahil Hod El Salamiyah North to admit of its being flooded from the branch of the Killabiyah Canal which syphons under Meâlla Canal.
20	,,	,, ,, ...	Culvert in left bank of Sayalah Sahel Hod El Sallamiya North to irrigate Sahel.
21	,,	,, ,, ...	Regulator at tail bifurcation of Killabiya Canal.
22	,,	,, ,, ...	Prolongation to "Mawati" of Sayyalah Hod Hillah Der.
23	,,	Ghilassi ,, ...	Extension of Ghilassi Canal southwards through existing khors.
24	,,	,, ,, ...	Red water feeder for Hod Hisha.
25	,,	Ramadi ,, ...	Canal starting from Gebel Silsita to feed Ramadi basins.
26	,,	,, ,, ...	Three feeder culverts in left bank of Ramadi Canal to feed Hod Edfu, and three corresponding Sayalahs.
27	,,	,, ,, ...	West branch to Kandiliyah Sayyalah Hod Edfu.
28	,,	Asfun ,, ...	Drain from "Mawati" of Hod El Riti to Asfun Canal.
29	,,	Killabiya ,, ...	Prolongation of Sayalah Sharawna southwards to give water at a higher level to Hod Hilla-Der.
30	,,	Fadiliyah ,, ...	Bank to cut off southern portion of Hod Qamoula, and regulating culvert in feeder Sayalah.
31	,,	Bayadiyah ,, ...	Division of Hod El-Ashi West.
32	,,	Shanhariya ,, ...	Right bank for tail of Bayadiyah Canal Hod Damamil, and head regulator for Sayala Higazah.
33	,,	,, ,, ...	Division of Hod Qift East and construction of feeder canal for east portion.
34	,,	,, ,, ...	Regulating Hod for Sheikhiyah Canal.

Serial Number.	Circle.	Province or System.	DESCRIPTION OF WORK.
35	5th Circle	Ghilassi system ...	Regulating Hod for Samata Canal.
3	Girga Dir.	Khiyam „ ...	Culvert in N.le Tarrad of Hoshah Awlad Khalaf for irrigation of Sahel.
4	„	Akmim „ ...	Head regulator for Shanshifi Sayalah on right bank of Isawiyah Canal.
5	„	„ „ ...	Culvert in right bank of Isawiyah Canal at head of northern borrow-pit of Hoshah Nag Sawameâ to feed Saqulta Basin.
6	„	„ „ ...	Culvert for head of Akhmim Sayalah.
7	„	„ „ ...	Culvert for Hawawish Sayyalah in Akhmim south bank.
8	„	South Sohag „ ...	Division of Hod Bardis East.
9	„	„ ...	New channel taking off upstream of Abu Shushah Regulator, Rashwaniyah Canal, and syphoned under Kasra Canal to feed Um Tubul Canal for irrigation of Sahils Baliana and Bardis.
10	„	„ „ ...	Feeder for Hod Bayadi from Um Tubul Canal.
12	„	„ „ ...	Head for Barkheil Sayyalah, Kasra Canal.
14	„	„ „ ...	Head Regulator for Hakim Sayalah Sohag east basin.
15	„	North Sohag „ ...	Supplementary syphon under Tahtawiyah for Qilfaw Canal.
16	„	„ „ ...	Culvert in Nile tarrad of Hod Muaifin to irrigate Sahil Gheziret El Qaramta and Shandawil.
17	„	„ „ ...	Culvert to feed southern borrow-pit of Enebis Salibah in east and west banks of Tahtawiyah Canal.
18	„	„ „ ...	Head Regulator for Sayalah Wadea.
22	„	„ „ ...	Culvert in Nile Tarrad of Hosha Tima to replace cut.
23	„	Abnoub „ ...	Culvert in Nile Tarrad of Hosha Shaqilkil for sarf of that Hosha and Hod Beni Mohamed.
24	„	Khiyam „ ...	Head regulator, Hawis Canal.
25	„	Ahmim system ...	Head regulator, Lahaywa Canal.
26	„	„ „ ...	Culvert, left bank of Isawiyah Canal, downstream of Salamoni bridge to feed Hod Sawamaâ.
27	„	South Sohag system.	Head regulator for Um Tubul Canal in bank of Rashwaniyah Canal.
28	„	„ „ „ ...	Widening first kilometre of Zarguriya Canal
29	„	„ „ „ ...	Head Regulator for Ambariyah Sayalah, Girgawiyah Canal, downstream of Labaywa syphon.
30	„	North Sohag „ ...	Head regulator for Shatturah Canal.
31	„	„ „ „ ...	Regulating culvert, Baja Sayala, opposite Qilfaw.
32	„	„ „ „ ...	Escape in Baja Saliba to sarf Hod Baja into old Beni Hilal Canal.

Serial Number.	Circle.	Province or System.	DESCRIPTION OF WORKS.
33	Girga Dir.	North Sohag system	Escape for Hod Awlad Naser into Girgawiyah Canal.
34	„	„ „ „ ...	Heads for Naga Tammam east and west Sayalahs.
35	„	„ „ „ ...	Prolongation of Kom Badr West and Soffeha canals to meet Hod Um Dumah West escape channel.
36	„	„ „ „ ...	Prolongation of Beni Harb Canal into Hod Um Dumah East to western saliba regulator.
37	„	Khizindariyah „ ...	Culvert in Ofadra bank to irrigate Sahel Hosha North and sarf Sahil Hosha South.
1	4th Circle	Asyut	Syphon under Ibrahimiyah Canal to connect Hods Mullah and Walidiyah.
2	„	Beni Suef	Syphon under Magnunah Canal to carry water from Ibrahimiyah to the basins east of railway and north of Ashmant.
3	„	Asyut-Delgawi syst.	New canal through Hod Beni Khaled to replace Itqa Canal.
4	„	„ „ „	Escape in Saliba Beni Khalid.
5	„	West-Yusufi S. „	Increasing water-way of Saliba Naglet El-Abid bridge.
6	„	„ „ „	Increasing water-way of Saliba Tukh bridge.
7	„	„ „ „	Increasing water-way of Salibah Qamadei bridge.

Special Sharaki measures and expenditure.

The following statement shows the expenditure incurred on special measures for prevention of "Sharaki," such as making and repairing banks round sahils and ghezirehs:—

CIRCLE.	EARTHWORK EXECUTED.		Expenditure on Sundries.	Total Expenditure.
	Cube.	Cost.		
	C.M.	£E.	£E.	£E.
5th Circle	101,145	1260	40	1300
Girga Directorate ...	45,853	700	—	700
4th Circle	300,000	2000	—	2000
Totals... ...	346,998	3960	40	4000

The above expenditure was provided for by a special Caisse Grant.

The "Sharaki" areas were as follows:—

PROVINCE.	SHARAKI AREAS.		TOTAL.
	Hods.	River Sahels and Islands.	
Aswan	1,039	642	1,681
Kena	609	115	724
Girga	—	1,000	1,000
Asyut	10	1,020	1,030
Minia	—	3,406	3,406
Beni Suef	—	1,268	1,268
Totals... ...	1,658	7,451	9,109

Final figures have not yet been received for Minia Province. Judging from those which have come in it appears that the area of 3,406 feddans given above is considerably in excess of the truth. The "Sharaki" areas for 1900 and 1980 were 12,730 and 16,461 feddans respectively. Comparing the maximum and mean flood gauges for the three years, the figure of 9,109 feddans is distinctly satisfactory.

SECTION IV.—FLOOD WATCHMEN.

The total number of men called out was 18,907. The average number of days they remained out was forty-five. The total number of days' labour was 856,089. Nile Corvée.

The number of days' labour in 1893, 1897, 1900, years of very similar flood was, as follows:—

Years.	Number of days' labour.
1893	2,125,000
1897	848,490
1900	1,177,545

The long lengths of new channels and banks accounted for a good deal of the labour. The distribution of the flood watchmen is shewn in the following statement:—

NUMBER OF CORVÉE MEN CALLED OUT DURING THE NILE FLOOD OF 1901.

CIRCLE AND PROVINCE.	NILE BANKS.				BASIN BANKS.				CANAL BANKS.				BRIDGES.				RESERVE.		TOTALS.	
	Number of men called out.	Average number of days out.	Length of banks in kilometres.	Average number of men per kilometre.	Number of men called out.	Average number of days out.	Length of banks in kilometres.	Average number of men per kilometre.	Number of men called out.	Average number of days out.	Length of banks in kilometres.	Average number of men per kilometre.	Number of men called out.	Average number of days out.	Number of bridges.	Average number of men per bridge.	Number of men called out.	Average number of days out.	Number of men called out.	Average number of days out.
4TH CIRCLE.																				
Fayum...	—	—	—	—	182	62	10	18	327	95	69	5	101	99	—	—	—	—	610	85
Beni Suef	382	48	85	5	1706	41	165	10	108	48	86	1	30	45	—	—	455	68	2681	50
Minia	381	47	192	2	2783	36	464	6	112	82	107	1	203	61	47	5	750	2	4229	35
Asyut North	123	34	118	1	830	40	136	6	337	45	139	2	376	72	—	—	—	—	1666	48
Total	886	—	395	2	5501	—	775	8	884	—	401	2	710	—	—	—	1205	—	9186	45
GIRGA DIRECTORATE.																				
Asyut South	430	60	153	3	406	49	104	4	176	56	99	2	300	69	87	3	14	56	1326	58
Girga	799	54	231	3	1652	55	290	6	1970	54	532	4	550	64	213	3	—	—	4971	56
Total	1229	—	384	3	2058	—	394	5	2146	—	631	3	850	—	300	3	14	56	6217	57
5TH CIRCLE.																				
Kena	230	30	123	2	535	31	185	3	520	33	291	2	544	65	227	2	1515	2	3344	24
Aswan	18	45	5	3	20	34	3	7	57	39	29	2	45	46	23	2	50	5	190	32
Total	248	—	128	2	555	—	188	3	577	—	320	2	589	—	250	2	1565	—	3534	25
Grand Totals	2363	—	907	2·6	8114	—	1355	6	3607	—	1352	2·5	2149	—	—	—	2784	—	18937	45

SECTION V.—DRAINAGE.

The expenditure on construction and remodelling of drains will be treated of under the head of "Special Works." No work of this description was charged against the Ordinary Budget.

In the clearance of drains a cube of 68,500 cubic metres was executed at a cost of £E. 971.

Levels of Lake Qarun.

The following table gives the levels of Lake Qarûn on the 1st March for the past eighteen years:—

YEAR.	Level of lake in metres below sea-level.	Fall in previous 12 months.	YEAR.	Level of lake in metres below sea-level.	Fall in previous 12 months.
1885	39·89	Unknown.	1894	43·84	0·06
1886	40·00	0·20	1895	44·17	0·33
1887	40·38	0·38	1896	44·16	0·01 rise.
1888	40·73	0·35	1897	44·27	0·11 fall.
1889	41·17	0·44	1898	44·32	0·05 „
1890	42·00	0·83	1899	44·25	0·07 rise.
1891	42·78	0·78	1900	44·10	0·15 „
1892	43·32	0·54	1901	43·90	0·20 „
1893	43·78	0·46	1902	44·19	0·29 fall.

The total fall for the past seventeen years has been 4·39. Since the level began to fluctuate in 1896 there has been a net fall of 0·02.

Part. II.—SPECIAL WORKS.

(*Chargeable to Special Caisse Credit and to Special Grant from Ordinary Budget.*)

The sum available for expenditure on special works during the year was £E.372,905.789, made up as follows:—

	£E.	Mill.
Special Caisse Grant	334,059	590
Special Grant from Ordinary Budget	38,846	199
Total	£E.372,905	789

The total expenditure was £E.356,564.737 leaving a balance of £E.16,341.052 to be carried forward. A sum considerably in excess of the latter sum was due for land at the end of the year.

Appendix F gives a general abstract shewing the partition of the expenditure on the various projects. Appendices G and H give lists of the various masonry works, the new channels and banks constructed, and the existing channels remodelled during the year.

The projects taken in hand or advanced during the year were the following:—

In the 4th Circle.

West Yusufi basins, Minia Province.

Extension of West Muhit drain across Hod Sultani to Yusufi. Construction of Walidiya syphon under Ibrahimiyah Canal‘ Asyut Province.

In the 4th Circle.

Magnuna syphon, Beni Suef Province.

Fayoum remodelling works.

In the 5th Circle.

Hamad Escape and out-fall channel.

Three feeder culverts and one escape.

In the Projects Circle.

Conversion of the Asyut basins between the Ibrahimiyah and Bahr Yusef canals into perennial tracts.

Remodelling the Ibrahimiyah Canal.

Diversion of the Bahr Yusef in Hod Qurun.

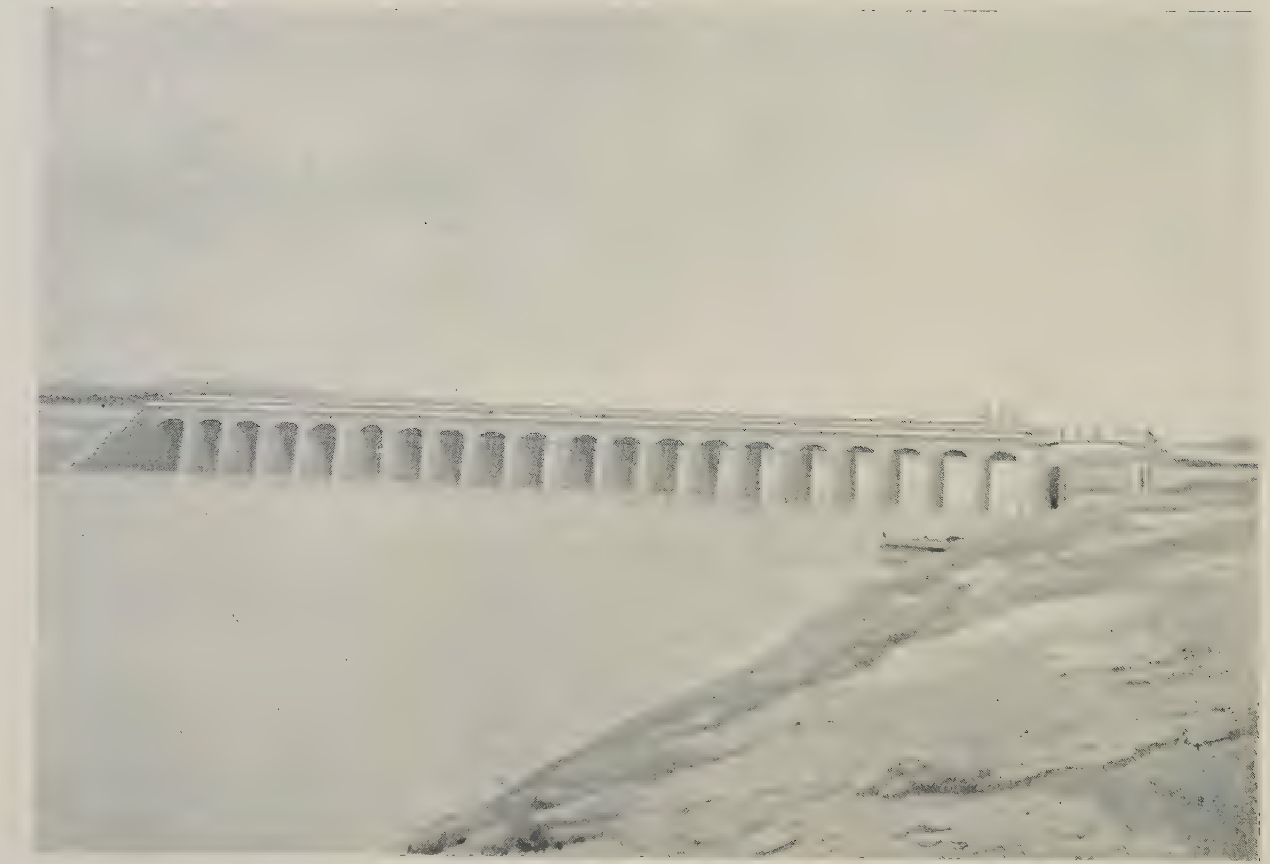
Etsa pumping station.

In Girga Directorate.

Talihat Regulator on Sohagiya Canal.

Four regulating heads for distributaries of Sohagiya Canal.

Plate III.



SUR. DEPT. P.W.M.

Saqula Regulating Bridge.

West of Yusufi Project.

Work on this project was commenced in 1899. At the end of 1900 the basin banks and regulating bridges had been completed. The fine Nezlet El Abid Regulator and Lock had also been entirely, and the Saqula Regulator and Lock, a work of equal dimensions, partially completed. These Regulators each consist of twenty 3-metre vents and a lock-channel provided with a lift bridge. The expenditure up to the end of 1900 was £E.156,939. During 1901 a further expenditure of £E.34,642 was incurred, making the total expenditure to date £E.190,981.

The project estimate for the work was £E.200,000, which results have shown to be a good estimate, as little now remains to finish off the work.

The expenditure during the year was incurred on the following items:—

(1) Completion of Saqula Regulator and Lock;
(2) Stone revetement of banks;
(3) Land charges.

The experience of the last two years has shown that the water-way of three of the Salibah Regulators in the southern system, commanded by Nezlet El Abid Regulator, will have to be increased. A large hole scoured out downstream of Salibah Shushah bridge during the flood of 1900, wich necessitated the extension of the wing-walls and floor at a cost of £E.968. The revetment of the Salibah banks was completed during the year. The revetment of exposed portions of the tarrads, the increase of the water-way of the Salibah bridges, mentioned above, the erection of lock gates and lift-bridge at Saqula, and quarters for regulating establishment, are the only items now remaining to complete the project. Both southern and northern systems were successfully filled during the past flood. The southern system exhibited some small defects, noted above, the northern system proved very satisfactory.

Mazurah Regulator and Lock.

The objects of this work were explained in last year's report. It is hoped in the early future to construct a system of West Yusufi basins in Beni Suef Province, where there is an area of 33,000 feddans capable of being transformed into rich basin land from a wide Sahil which gets one flooding of all too short duration with sarf water. The work was practically completed and used for regulation during the year.

The expenditure up to the end of the year was £E.53,381.

Extension of West Muhit Drain.

The object of this work is to divert part of the drainage of the perennial tract of Minia Province into the Bahr Yusef below Mazurah Regulator. Part of the channel was excavated during the year, and a tail fall at the inlet to the Yusufi built. Pipes were procured for a syphon over which the present flood discharge for Sultani basin, and a future sefi canal will pass.

The expenditure during the year was £E.5,283. The work will be completed during 1902.

Walidiya Syphon.

The object of this work is to ensure the irrigation of Hod Walidiyah east of the Ibrahimiyah Canal, which is fed directly from the river, and always suffers in years of low flood, by putting it in communication with Hod Mallah, west of the Ibrahimiyah, the central basin of the well-commanded Sohagiya system. The 1·5-metre pipes required for a syphon of two barrels under the Ibrahimiyah were landed at the site of the work during the year, and a payment of £E.1,500 made on account of them.

The syphon should be ready before the flood of 1902.

Magnuna Syphon.

The object of this work was explained on page 90 of last year's report. The pipes were obtained during the year, and the work will be completed before the flood of 1902.

Fayum Remodelling Projects.

These projects were the following :—

(1) Construction of Hassan Wassif Canal.
(2) Remodelling Bahr Nezlah and branches commenced in 1900.
(3) Remodelling Tagin Drainage system commenced in 1900.
(4) Metartaris-Alam Canal's project.
(5) Remodelling Bahr Seilah.

Hassan Wassif Canal.

The objects of this canal were explained in page 74 of last year's report. The canal was completed during the year, and used during the flood. The expenditure during the year was £E.57,210. A sum of £E.4.655 remains to be paid for land in 1902 which makes the total cost of the canal £E.61,865. Much more rock-cutting was encountered than the trial pits indicated, which made the channel more costly than anticipated, but there was no alternative, as to try and widen the Yusufi would have been more costly still. The area served by the canal is 106,000 feddans. The works carried out in connection with the project during the year, besides the excavation of the channel, included a fine head shirce, four road-bridges, and a tail escape.

The items of work executed in connection with this project during the year were:— Remodelling Bahr Nezlah and branches.

(1) Rock-cutting of first reach of the main canal.
(2) Second reach of main canal was remodelled.
(3) Second reach of the chief branch, the Bahr Kasr El Banat, was completed, and the third reach put in hand.
(4) Minor masonry works costing £E.3,185 were constructed.
(5) The Difinu road-bridge on the main canal, and the Tagin acqueduct, carrying the same channel over the main Tagin drain, were completed.

The expenditure during the year was £E.30,985.

Tagin Drainage System.

30·60 kilometres of drainage channels were remodelled or constructed at an expenditure of £E.12,182. The improvement in the tract served by these drains is very marked.

Metartaris Alam Projects.

This project was completed during the year, and consisted in suppressing the old Bahr Mitartaris, to feed which, water had to be held up to an objectionably high level in the Bahr Tanhalla, and transferring its irrigation to the Bahr Alam and Edwah systems, which are separated by a newly-constructed drain.

Remodelling Bahr Seilah.

There is a large area of Kharig ez ziman land lying east and north of Rodah and Tamyah villages in the north-east of the Fayoum, to irrigate which it is proposed to construct a high-level canal to be called the Abdallah Wahbi, following approximately the alignment of the old Wardan Canal. This new canal will take off from the end of the first reach of the Bahr Seilah. The first reach of the Bahr Seilah must therefore be enlarged, and a sum of £E.2,700 was spent in this work during the year.

Inspection houses.

Three useful inspection houses at Tamiyah, Seilah and Abuxsa were built during the year at a cost of £E.1,082.

Hamad Escape

The old Hamad Escape in Keneh Province, which failed during the flood of 1900, was replaced by a fine solid work of six 3-metre vents, costing with its approach and out-fall channels £E.13,500.

Talihat. Regulator.

The floor of a fine regulator of twenty 3-metre vents, at Talihat on the Sohagiya Canal, was completed. Head regulators were also built for the Kom Badr, Harafsha, Beni Harb, and Soffeiha basin canals taking off from the Sohagiya.

The expenditure on these works was £E.12,000.

Conversion of Asyut basins.

The four basins of Tanda, Tanuf, Ashmunin and Etqa, with an aggregate area of 52,665 feddans, situated north of Deirut between the Bahr Yusef and Deirutiyah canals, were converted into perennial tracts during the year. Another small basin of 5,420 feddans, lying east of the Deirutiyah Canal between Deir Moes and Mellawi, was also converted, which makes the total area converted during the year 58,085 feddans.

The following lengths of channel were constructed in these basins:—

	Kilometres.
Canals having bed-widths at head of from 4·5 to 2·0 metres ...	70·6
Distributaries having bed-widths of from 1·30 to 0·50	179·6
Main drains having bed-widths at the tail of from 4·25 to 1·40 metres	53·5
Branch drains having bed widths of from 1·00 to 0·40	73·6
Total...	377·3

The expenditure on the actual conversion works, including arrears due for land, during the year was £E.109,577.933. The expenditure on remodelling the Ibrahimiyah Canal and Etsa Pumping Station is not included in the above figure, as the cost of these works will have to be spread over the entire area of basin land in Middle Egypt converted into perennial, and I only here desire to arrive at a figure for cost of conversion works proper in the basin themselves. To entirely complete the perennial system in the area of 58,085 feddans mentioned above, a sum on £E.22,000 has been allowed for in the programme for 1902. To this may be added a sum of £E.3,455 incurred on the preparation of the project, and preliminary field operations, thus raising the total figure for expenditure on conversion works proper to £E.135,032, dividing this sum by the area converted (58,085 feddans) we arrive at £E.2.330 as the rate per feddan for conversion. I may remark that the cost of conversion in this system was kept low owing to the fact that the main feeder canal for the system, the Deirutiyah, was already in existence, and also that land was obtainable at a lower rate than it will be in the Minia or Beni Suef Provinces.

On the 10th August water was admitted to the new canals, and an area of 17,024 feddans of dhurah was sown, of which the gross value may be taken as £E.102,144 and the net value, after deducting the cost of cultivation, as £E.85,120. As the entire area of these basins was subsequently put under shitwi crops the figure of £E.85,120 represents the increased return obtained from the area of 58,085 feddans owing to the alteration of the system of irrigation. In 1903 a considerable area of Sefi crops may be expected in the same area, and the value of the outturn per feddan, will show a corresponding increase. In view of the above facts the proposed increase of taxation of P.T.50 per feddan appears a very moderate demand.

Mr. Hopkins, Inspector in the Ministry of Finance, has favored me with an intersting note regarding the increase of selling price and rentals, up to date, in the villages effected by the conversion works. The increase of selling price over the whole area he puts at £E.15 per feddan. The mean increase in rental of land, with free-flow irrigation, appears to be P.T.150, and for land which will have to be irrigated by lift P.T.100. Mr. Hopkins gives instances of contracts where the rental value has risen from P.T.275 to P.T.500 and from P.T.300 to P.T.600.

Remodelling the Ibrahimiyeh Canal.

The work of increasing the section of the Ibrahimyah Canal was commenced in the reach of 16 kilometres between Minia and Etsa. A cube of 443,328 cubic metres was executed in this length. A regulator was built at Hafiz below the off take of the Sabakhah Canal, the main feeder channel for the Minia basins, of which the conversion commenced in 1902. The old timber bridge carrying the Daira Sanieh Railway over the canal at Feshn was replaced by a substantial iron bridge. The Minia and Sharana regulators were remodelled and four head-sluices were built for branch canals. An Inspection House was built at the site of the Hafiz Regulator. The expenditure, including sums due for land, was £E.28,225·908.

Diversion of Bahr Yusef.

This work consisted in cutting off a very exaggerated loop 1,600 metres deep with a length of only 500 metres between the ends, and thus getting a clear course for the Sabakhah Canal. This work really forms a portion of the conversion works of the Minia basins. The cube of earthwork executed was 375,420 cubic metres and the cost, including land, was £E.10,831·160.

Etsa Pumping Station.

This station is destined to discharge a portion of the drainage of the Sefi tracts of Asyut and Minia Provinces into the river during flood. The installation will consist of four 40″ pumps driven by four vertical compound engines, and will be capable of discharging 8 cubic metres per second on a lift of 4½ metres. The contract for the plant has been given to Messrs Easton & Anderson, and it is proposed to commence work on the station in May 1902, and complete it before the flood of 1903. The expenditure during the year was £E.5,561·601.

Part III.—WORKS AND ESTABLISHMENT.

SECTION I.—MAINTENANCE AND REPAIRS.

Details of the quantities of earthwork executed during the year and its cost are given in Appendix D. The total quantities are as follows:—

CIRCLE.	By Hand.		Dredging.	
	Quantity.	Cost.	Quantity.	Cost.
	C.M.	£E.	C.M.	£E.
4th Circle	4,587,909	55,970	459,536	16,000
5th Circle	2,602,350	31,762	—	—
Girga Directorate ...	2,402,244	26,227	—	—
Totals... ...	9,592,503	113,959	459,536	16,000

The following sums are still due on the above cubes:—

	£E.	Mill.
In 5th Circle	828	419
Ibrahimiyah Dredging	1,232	000

Adding these sums to columns 3 and 5 we obtain £E.32,590 and £E.17,232 as the actual cost of the work. The average cost per cubic metre of earthwork by hand was as follows:—

	P.T.
4th Circle	1·22
5th Circle	1·25
Girga Directorate	1·09

These rates are quite normal. The figures for the 5th Circle include a cube of $321,034^3$ for clearance due to the choking of canals in Keneh Province by debris carried down from the hills during severe rainstorms in March and April. To assist in meeting this extra call on the ordinary Repairs Budget allowance a grant of £E.2,000 was made by the Caisse de la Dette, which rendered it possible to put the channels in good order, and proved to be money well-spent, seeing the feeble character of the flood.

The cube of ordinary earthwork executed in the 4th Circle was considerably below the average of the last few years. The dredging bill for the Ibrahimieh Canal was, however, the highest since 1891.

The following are the causes which contributed to increase the cube of dredging; Firstly, the long channel connecting the head of the canal with the main stream of the river, in which dredgers had to be kept working up to an advanced date; Secondly, the closure of the head and opening of a diversion channel in connection with the construction of the new head regulator. Severe scour at the head of the diversion channel was caused by the interference of the Barrage works with the regime of the river, and a large deposit of silt was thus caused in the head reach of the canal, over which the dredgers had to pass twice.

Dredging in the Ibrahimiyeh Canal.

The following table shows the quantities dredged in the Ibrahimiyah Canal during the last eleven years:—

YEAR.	QUANTITY IN CUBIC METRES.			COST IN £E.
	Asyut to Deirut.	In River at Asyut.	Total.	
1891	836,116	—	836,116	30,591
1892	413,088	—	413,088	15,597
1893	371,926	—	371.926	14,400
1894	448,026	—	448,026	16,888
1895	351,253	—	351,253	13,225
1896	300,706	—	300,706	11,347
1897	214,212	—	214,212	8,196
1898	247,813	—	247,813	9,374
1899	129,367	—	129,367	4,872
1900	201,656	66,925	268,581	10,555
1901	312,457	147,079	459,536	16,000

Ibrahimiyeh Canal spurs.

There was no expenditure on the spurs in the Ibrahimiyah Canal during the year.

River protective works.

The following statement shows the cubes of stone purchased and built into river spurs and revetments during the year, and the expenditure incurred on transporting and building Government stone into the same:—

CIRCLE.	New stone.		Expenditure on transporting and building Gov^t. stone.	Total Expenditure
	Cube.	Cost.		
	C.M.	£E.	£E.	£E.
4th Circle	8,601	1,395	113	1,508
5th Circle	6,091	936 (a)	—	936
Girga Directorate ...	4,649	897	323	1,220
Totals... ...	19,341	3,228	436	3,664

(a) A sum of £E.340,465 was due as the end of the year on this cube.

Besides the above a length of 326 metres of the Nile tarrad at Mataana was revetted in the interest of the Daira Sanieh Administration which allotted a credit of £E.636 for the purpose. Only one new spur was built, at Luca in Asyut Province. The rest of the work consisted in repairing and extending revetments.

The following expenditure was incurred on revetting canal banks below regulators and other important points:—

CIRCLE.	New stone.		Transporting and building.	Total cost.
	Cube.	Cost.		
	C.M.	£E.	£E.	£E.
4th Circle	7,528	1,578	—	1,578
5th Circle	—	—	—	—
Girga Directorate ...	1,659	409	65	474
Totals... ...	9,187	1,987	65	2,042

SECTION II.—NEW WORKS AND IMPROVEMENTS.

(Exclusive of Special Works).

The quantity and cost of earthwork executed in new channels and banks, exclusive of special works, was as follows:—

CIRCLE.	New Channels and Banks.			
	Quantity.	Cost.	Cost of land.	Total cost.
	C.M.	£E.	£E.	£E.
4 h Circle	222,731	2,740	—	2,740
5th Circle	246,206	3,035	822	3,857
Girga Directorate ...	80,515 (a)	976	741	1,717
Totals... ...	549,452	6,751	1,563	8,314

The lengths of the new channels and banks are given in the following statement:—

CIRCLE.	LENGTH IN KILOMETRES.	
	New Channels.	New Banks.
4th Circle	32,146	4,717
5th Circle	33,272	—
Girga Directorate...	3,172	2,444
Total	68,590	7,161

(a) Includes 746 cubic metres rock-cutting not included in Appendix D.

The details of the work executed are given in Appendix E. The principal items were a new drain in Hod Delgawi, Sharkas Canal, in Asyut, and the prolongation of the Damranyiah Canal to Salibah Samhud in Keneh Province.

Basin bank protection.

Appendix K shows the progress made with revetting basin banks, the quantity of stone used and its cost. The total length revetted was 42,924. The average quantity of stone used per metre run was 1·85 cubic metres, and the average cost per metre run was £E.0·590. Out of the 42,924 lineal metres a length of 36,221 was done in the west of Yusufi basins, and on the Mazurah Salibah and Bakir bank, which come under the head of "Special Works." In Kena Province a length of 3,434 metres was revetted at the request of the Daira Sanieh Administration which furnished a credit of £E.1,112·094 for the work. A sum £E. 500 was spent in Girga on repairs to revetments.

New masonry works for irrigation.

A list of new masonry works and buildings charged to the Ordinary Budget is given in Appendix B. On works for the improvements of irrigation the expenditure was £E.5,196·546 and on buildings £E.1,188·680, Most of the new works were built in Girga Directorate where money is not as tight as in the other circles. The principal works were head sluices for the Girgawiyah and Maabda canals, and a regulator on the Qaw Canal. A substantial office was built for the Director of Works at Sohag.

Masonry works remodelled and repaired.

Appendix C gives a list of the masonry works repaired and remodelled. In the 5th Circle thirteen works were repaired. The most important was the syphon carrying the Rannan Canal under the Damraniyah Canal.

In Girga Directorate twenty works were repaired, of which the most important was the Shattura syphon, which was remodelled, and had its water-way enlarged.

In the 4th Circle numerous petty repairs were executed on general repair estimates. An important work was the repairs of the big Abu Baqara acqueduct in the Ibrahimiyah Canal which failed during the flood of 1900. A massive new wing had to be built on to this aqueduct at a cost of £E.1,966. A sum of £E.592·575 was spent on repairs and painting of Koshesha Escape.

SECTION III. — AGRICULTURAL ROADS.

Agricultural roads.

The expenditure on construction of new roads in the Fayoum Province during the year was £E.1,443. The following statement shows the progress made with the programme of new roads for the Fayoum approved of in 1898 :—

Length included in 1898 programme.	Cunstructed up to end of 1900.	Constructed during 1901.	Total to end 1901.
Kilometres.	Kilometres.	Kilometres.	Kilometres.
222·0	98·5	4·0	102·5

Progress with the new roads was purposely delayed owing to the numerous new channels projected or under construction, as it appears probable that some of the proposed new roads can be carried along the banks of new or remodelled channels. This was done during the past year in the case of the Hawaret El Makta-Lahun road, which has been carried along the bank of the new Hassan Wassif Canal. Including this length of 11 kilometres the actual progress with the roads up to date has been 113·5 kilometres.

The amount of earthwork executed in repairs to roads is shown in Appendix D. The expenditure was £E.2,064.

SECTION IV. — BRIDGES TO REPLACE FERRIES.

Bridges to replace ferries.

During the year two iron girder bridges with timber platforms, screw pile piers, and masonry abutments were constructed on the Ibrahimiyah Canal at Ibiouha and El Kefour. The expenditure incurred during the year was as follows:—

	£E.	Mill.
Balance due on Hawasliyah bridge	157	340
Ibiouha bridge	1,443	605
El Kefour bridge	1,399	055
Total...	3,000	000

Canal bridges in Girga Directorate.

In Girga Province fourteen bridges costing £E.7,309·196 were built on the Girga canals. The bridges are solid structures with masonry abutments and piers, and timber platforms. These fourteen bridges form part of a programme for forty-nine bridges costing £E.27,113 accepted by the Provincial Council in 1900. The cost is defrayed by a special cess on the cultivated area of the Province.

Kena Province has recently followed the lead of Girga, and the Provincial Council has accepted a programme for bridges to be paid for by a special cess as in Girga.

These instances show what store the rural population sets on good communications.

SECTION V.—WORKS OF PRIVATE ENTREPRISE.

Agricultural railways in Fayum Province.

Line No. 10, between Gabala and Senoures, 5 kilometres in length, was completed and opened to traffic during the year. The line from Miniet El Het to Shawashna, viâ Abu Gandir and Nezlah, was practically completed but is not yet opened. This line replaces lines No. 8 and 9 of the original programme, which has now been carried out in full. One extra line from Fayoum to Edwa, 7 kilometres in length, was constructed last year. The total kilometrage of line made amounts to 162 against 146½ of the original programme.

Nile reclamation works.

The *New Egyptian Company* started operations, in the matter of reclaiming land in the flood-spill channels of the river, on a khor opposite Sohag. The khor has two mouths at its northern extremity, separated by high ground; one mouth was provided with a dry stone weir by means of which the discharge through the khor was regulated, the other mouth was closed by a massive sadd with pitched faces. The Company's Chief Engineer declares himself well satisfied with the results obtained during the past flood, as regards mud-deposit in the khor. A considerable area of the newly reclaimed land in the khor was rented out for shitwi crops.

The Company has been authorised to carry out works at several sites in 1902.

SECTION VI.—EXPENDITURE DURING THE YEAR.

An Abstract of the Expenditure during the year is given in Appendice A and is as follows:—

	£E.
Establishment and contingent charges...	34,080
Works...	534,692
Total...	568,772

SECTION VII.—ESTABLISHMENT.

Mr. Clowes had a very busy year in 4th Circle, with an expenditure of £E.183,600 on special works. The sarf operations under the new conditions introduced by recent works and extensions were also complicated. They were personally superintended by Mr. Clowes throughout, to the great advantage of all concerned.

Mr. Ireland, Director of Works, held charge of the Circle during Mr. Clowes's absence on leave. Mr. A. G. Sachs, Director of Works, did excellent service as engineer in charge of the big Yusufi Regulator. Abdulla Bey Wahby, Director of Works, worked up to his reputation in charge of the important Fayoum works. The Chief Engineers in the 4th Circle managed the summer distribution well, and Talaat Bey, Chief Engineer of Minia, is complimented by his inspector on his conduct of the sarf operations. Ismail Bey Sirry and his staff got through a lot of work in the conversion of the Asyut basins. It was particularly creditable that the entire area of the converted basins was successfully irrigated and yielded excellent flood and winter crops. To attain this result required a large expenditure of time and patience to induce the cultivators to do the needful in the shape of preparing their field watercourses in time. Hearty thanks are due to S. E. Hishmat Pasha, Mudir of Asyut Province, for his assistance in this matter. The flood irrigation of the 5th Circle and Girga was very successfully carried out by Sidky Bey, Inspector of Irrigation, and Hassan Bey Wassif, Director of Works. One has to study the careful reports of these two officers to know what careful and unremitting attention is required to prevent large areas of Sharaki in years of poor flood such as the last three years have been.

K. E. VERSCHOYLE,

Inspector General of Irrigation,

Upper Egypt.

APPENDICES.

APPENDIX A.

ABSTRACT OF EXPENDITURE IN 1901 UNDER THE DIFFERENT SUB-HEADS OF THE BUDGET.

SUB-HEADS OF BUDGET.	EXPENDITURE.				
	4th Circle.	Projects.	5th Circle.	Girga.	Total.
	£E.	£E.	£E.	£E.	£E.
SUB-CHAP. I.—*Establishment.*					
Classified	9,709	1,412	4,033	3,858	19,012
Hors Cadre	3,904	—	1,256	1,178	6,338
Total, Sub-Chap. I ...	13,613	1,412	5,289	5,036	25,350
SUB.-CHAP. II.					
Travelling Allowances	4,032	—	1,187	1,335	6,554
Telegrams	175	—	98	98	371
Dahabiyahs	487	—	411	468	1,366
Office Rent	161	—	104	131	396
Sundries	10	—	19	14	43
Total, Sub-Chap. II ...	4,865	—	1,819	2,046	8,730
SUB-CHAP. III.					
Furniture and instruments	50	—	16	175	241
SUB-CHAP. IV.					
New works and Sharaki prevention ...	2,940	2,977	—	891	6,808
SUB-CHAP. V.					
Repairs and Maintenance	9,989	—	4,630	5,500	20,119
SUB-CHAP. IV AND CORVÉE ABOLITION.					
Earthworks and works for decreasing the cost of maintenance of banks and channels	78,250	—	35,534	32,650	146,434
Special new works	19,100	10,863	1,465	1,500	32,928
SPECIAL "CAISSE" CREDIT.					
New Works	161,560	130,570	15,089	10,500	317,719
NEW AGRICULTURAL ROADS	1,443	—	—	—	1,443
SPECIAL CREDIT FOR SHARAKI WORKS ...	2,000	—	3,300	700	6,000
Ferry Funds	3,000	—	—	—	3,000
Total of Works ...	278,332	14,4410	60,034	51,916	534,692
Grand Totals ...	296,810	145,822	67,142	58,998	568,772

APPENDIX B.

List of new Masonry Works executed in 1901 and their Cost, exclusive of Special Works.

Name of Work.	Cost.	Total per Province.	Total per Circle.
	£E.	£E.	£E.
5th CIRCLE.			
Works for Improvement of Irrigation.			
Kena Province.			
Permanent Nile gauges at Esna and Nag Hamadi	297.241	297.241	
Buildings.			
Irrigation stores on Tukh and Awlad Amr Canals	40.082	40.082	337.323
GIRGA DIRECTORATE.			
Works for Improvement of Irrigation.			
Girga Province.			
Culvert for Hod Bardis east of Bashawaniyah	203.544		
Salibah Hammam east culvert	124.489		
Salibah Hammam west regulator...	515.375		
Girgawiyah Canal head regulator...	1,995.217		
Sayalah Beni Hilal culvert	167.518		
Regulator on Qaw Canal at Sabaykah Salibah with east and west feeder culverts...	739.995		
Nile gauge at Sohag	89.999	3,836.137	
Asyut.—2nd Section.			
Maabda Canal head regulator	563.168	563.168	
Buildings.			
Office at Sohag	1,148.598	1,148.598	5,547.903

LIST OF NEW MASONRY WORKS EXECUTED IN 1900 AND THEIR COST, EXCLUSIVE OF SPECIAL WORKS—*concluded.*

NAME OF WORK.	Cost.	Total per Province.	Total per Circle.
	£E.	£E.	£E.
4TH CIRCLE.			
Works for improvement of Irrigation or Drainage.			
FAYOUM PROVINCE.			
Government shares of combined road and railway bridges	500.000	500.000	500.000

ABSTRACT.

	£E.
5th Circle	337.323
Girga Directorate	5,547.903
4th Circle	500.000
Grand Total for Upper Egypt... ...	£E.6,385.226

APPENDIX C.

LIST OF MASONRY WORKS REPAIRED AND REMODELLED IN 1901 AND THEIR COST.

NAME OF WORK.	Cost.	Total per Province.	Total per Circle.	Grand Total.
	£E.	£E.	£E.	£E.
5TH CIRCLE.				
KENA PROVINCE.				
Repairs to Gebbalaw escape	219.673			
,, Abu Shusha escape	122.535			
,, Damraniyah Canal syphon	561.130			
,, Salibet Hamad east regulator ...	143.717			
,, Salibet El-Tewerat regulator ...	32.699			
,, Culvert El-Tewerat	16.556			
,, El-Ashraf bridge	11.357			
,, Qift east and west regulators ...	14.020			
Miscellaneous petty repairs	95.751			
Angle irons for bridge grooves and regulating timbers	240.330			
		1,457.968		
ASWAN PROVINCE.				
Repairs to Ramadi regulator	48.428			
,, Edfu Kilh escape	17.413			
,, Bimban and Khattara bridges ...	23.520			
Miscellaneous petty works	53.748			
		143.109	1,601.077	
GIRGA DIRECTORATE.				
ASYUT.—2ND SECTION.				
Repairs to Abu Tig escape	19.282			
,, Mûsia escape	7.000			
,, Shutb escape	23.432			
,, Selim escape	13.450			
,, Aqadma regulator...	19.300			
,, Abu Zabiba escape	31.712			
,, Osmaniyah regulator	17.100			
,, Shew regulator	82.013			
,, Masah Abnub escape	7.030			
,, Salibah Maabda regulator	37.372			
,, Beni Mohamed syphon...	32.577			
,, Miscellaneous petty repairs	9.732			
Angle irons for bridge grooves	52.069			
		352,069		
GIRGA PROVINCE.				
Remodelling Shattura syphon	661.181			
Repairs to Hamnan and Awlad Yehya escapes	53.876			
Repairing Sohag escape	91.751			
,, Mahamda regulator	21.868			
,, Hawidi canal head regulator ...	16.601			
		....		
Carried over...	—	—	1,601.077	

List of Masonry Works Repaired and Remodelled in 1899 and their Cost—*concluded.*

Name of Work	Cost.	Total per Province.	Total per Circle.	Grand Total.
	£E.	£E.	£E.	£E.
Brought forward			1,601.077	
Repairing Umur Dumah west escape	76,610			
„ Woshah Khanausa escape	14,758			
Miscellaneous petty repairs	278.412			
Angle irons for bridge grooves	123.141	1,338.198	1,690.267	
4th CIRCLE.				
Asyut Province.				
Petty repairs to bridges	450.000			
Travelling Nasbah, Deirut regulator	32.420			
Repairing Masbaha bridge	180.000			
Models of irrigation works	154.000	816.420		
Minia Province.				
Petty repairs to bridges	350.000			
„ arrears for 1900	375.065			
Repairs to Minia bridges, arrears	200.000			
„ Abu Bagara aqueduct	2,466.000			
Regulating timbers	125.000	3,516.065		
Beni Suef Province.				
Repairs to Koshesha gates	300.000			
„ inspection houses, including a well at Wasta	200.000			
Petty repairs to bridges	500.000			
Painting Koshesha escape	200.000			
Angle irons for bridge grooves	110.000			
Petty repairs, Koshesha escape	92.515			
Repairs to road bridges, arrears of 1900 ...	530.000			
Sunday petty repairs	160.000			
Regulating timbers	125.000	2,237.515		
Fayum Province.				
Repairs to inspection houses	200.000			
„ works, arrears for 1900	180.000	390.000	6,460.000	9,751.344

ABSTRACT.

	£E.
5th Circle	1,601.077
Girga Directorate	1,690.267
4th Circle	6,460.000
Grand Total for Upper Egypt...	£E.10,251.344

APPENDIX D.

EARTHWORK CHARGED TO REGULAR AND CORVÉE BUDGETS, UPPER EGYPT, 1901.

PROVINCE.	Repairs to banks.	Clearance of Nili canals and drains.	Clearance of Sefi canals.	Clearance of Sefi drains and new drains.	Closing cuts.	Sadds in canals.	New canals and banks.	Repairs to agricultural roads.	TOTAL.	COST.
	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	£E.
4TH CIRCLE.										
Fayum	15,140	—	278,345	—	—	—	—	116,857	410,342	5,600.000
Beni Suef	360,559	310,200	485,184	29,087	24,129	—	28,342	55,154	1,292,655	14,900.000
Minia	929,485	48,295	652,622	39,413	59,810	9,055	52,203	—	1,790,883	22,103.525
Asyut	475,893	234,430	234,796	—	6,724	—	142,186	—	1,094,029	13,366.475
Dredging Ibrahimiyah Canal	—	—	459,536	—	—	—	—	—	459,536	16,000.000
Total, 4th Circle	1,781,077	592,925	2,110,483	68,500	90,663	9,055	222,731	172,011	5,047,445	71,970.000
GIRGA DIRECTORATE.										
Girga	493,470	1,124,200	—	—	15,317	13,311	42,413	—	1,688,711	17,843.083
Asyut South...	264,249	400,056	—	—	8,703	3,169	37,356	—	713,533	8,383.980
Total, Girga Directorate...	757,719	1,524,256	—	—	24,020	16,480	79,769	—	2,402,244	26,227.063
5TH CIRCLE.										
Kena	316,596	1,495,231	15,998	—	9,754	15,975	246,206	—	2,099,760	25,742.090
Aswan	104,163	395,172	—	—	260	2,975	—	—	502,590	6,020.133
Total, 5th Circle	420,779	1,890,403	15,998	—	10,014	18,950	246,206	—	2,602,350	31,762.223
Grand Total	2,959,575	4,007,584	2,126,481	68,500	124,697	44,485	548,706	172,011	10,052,039	129,959.286

APPENDIX E.

STATEMENT SHOWING THE NEW BANKS AND CHANNELS MADE IN 1901, EXCLUSIVE OF "SPECIAL WORKS."

NAME OF WORK.	Length in kilometres.	Quantity of earthwork.	Total quantity.
		C.M.	C.M.
4TH CIRCLE.			
ASYUT PROVINCE.			
New west drain in Hod Delgawi	12·846	64,065	
Junction of Canal Geziret Shakh with Geziret El Hawata Canal...	—	40,529	
New channel from Dernawer Canal	0·955	5,557	
Canal Sharkas	13·500	5,653	
Extension of Canal Wanli...	4·845	9,736	
Diversion of river bank at Nezlet Mohamed Soliman... ...	0·900	16,646	142,186
MINIA PROVINCE.			
Diversion of river bank at Matahra...	0·265	3,871	
„ „ „ at Bahayn	0·570	11,909	
„ „ „ at Abou Shehata	0·571	10,065	
„ „ „ at Abou Hassiba	0·651	10,073	
„ „ „ round Abou Hassiba	0·173	4,061	
„ „ „ Nazlet Amran	0·710	12,224	52,203
BENI SUEF PROVINCE.			
Diversion of river bank to replace Cut Dibabiyah...	0·877	28,342	28,342
Total 4th Circle ...	—	—	222,731
5TH CIRCLE.			
KENA PROVINCE.			
Junction between Ghilassi Canal and Hamad Escape... ...	0·100	8,706	
Prolongation of Damraniyah Canal...	18·600	93,655	
„ Kher Abou Humar	3·065	24,364	
„ Kher El Halimi	1·760	17,749	
„ Sayalet El Ashshi East...	3·360	35,764	
„ Sayalet El Hilla	3·180	34,826	
„ Sayalet Zarnikh	3·307	31,142	246,206
Total 5th Circle ...	—	—	000,000

STATEMENT SHOWING THE NEW BANKS AND CHANNELS MADE IN 1901, EXCLUSIVE OF "SPECIAL WORKS"—*continued.*

NAME OF WORK.	Length in kilometres.	Quantity of earthwork.	Total quantity.
		C.M.	C.M.
GIRGA DIRECTORATE.			
GIRGA PROVINCE.			
Diversion of Sohagiya east bank at Hod Awlad Nasr ...	2·007	22,381	
,, of west Nile bank at Hod Beni Hilal	0·573	6,495	
Drainage channel for Mawati of Hod Kawamil	1·536	6,433	
Diversion of Nile bank at Hod Sahil Tukh	0·592	7,104	
			42,413
ASYUT PROVINCE.			
Diversion of Hassan Darwish Canal at Luca...	0·908	38,102	
			38,102
Total Girga Directorate ...	—	—	80,515

ABSTRACT.

	Cubic metres
4th Circle...	222,731
5th ,, ...	246,206
Girga Directorate	80,515
Grand Total ...	549,452

APPENDIX F.

General Abstract of Expenditure on "Special Works" charged to Special Caisse Credit and Special Grant from Ordinary Budget.

Name of Work.	Expenditure.			
	Ordinary Budget.	Caisse Credit.	Total.	Total per work.
	£E.	£E.	£E.	£E.
4th CIRCLE.				
A.—West of Yusufi Project, Minia Province.				
Regulator and lock at Nazlet El Abid... ...	475.000	—	475.000	
„ „ Saqula...	917.605	6,003.000	6,920.605	
Masonry works in basins...	968.303	—	968.303	
Earthwork...	—	1,500.000	1,500.000	
Land	—	3,984.499	3,984.499	
Rubble revetment	—	18,493.941	18,493.941	
Inspection house	500.000	—	500.000	
„ adjustment for 1900	1,200.000	—	1,200.000	
				34,042.348
B.—Construction of Mazurah Lock and Regulator	8,713.184	20,800.633	29,513.817	
Mazurah Salibah and stone sadd	—	1,672.528	1,672.528	
Mazurah inspection house	710.873	—	710.873	
				31,897.218
C.—Extension of west Mohit Drain across Hod Sultani.				
Earthwork...	—	1,000.000	1,000.000	
Land	—	1.910	1.910	
Masonry works...	581.940	3,700.129	4,282.069	
				5,283.979
D.—Walidiyah Syphon under Ibrahimiyah Canal	1,500.000	—	1,500.000	
				1,500.000
E.—Magnuna Syphon, Beni Suef	—	450.000	450.000	
				450.000
F.—Fayoum Remodelling Works.				
(1) *Surveys*	1,575.000	—	1,575.000	
Carried forward...	17,141.905	57,606.640	74,748.545	73,173.545

General Abstract of Expenditure on "Special Works" charged to Special Caisse Credit and Special Grant form Ordinary Budget (*continued.*)

Name of Work.	Expenditure.			
	Ordinary Budget.	Caisse Credit.	Total.	Total per work.
	£E.	£E.	£E.	£E.
Brought Forward...	17,141.905	57,606.640	74,748.545	73,173.545
(*2*) *Canals.*				
Land	21.000	1,021.062	1,042.062	—
Earthwork	—	79,159.770	79,159.770	—
Masonry works	3,370.000	12,014.478	15,384.478	—
Inspection houses	1,082.095	—	1,082.095	—
(*3*) *Drains.*				
Earthwork	—	8,457.640	8,457.640	—
Masonry works	425.000	3,300.000	3,725.000	110,426.045
	22,040.000	161,559.590	183,599,590	183,599.590
PROJECTS CIRCLE.				
A.—Conversion of Asyut Basins.				
Earth work...	—	—	37,704.590	—
Masonry works	—	—	28,256.915	—
Inspection houses	—	—	4,189,315	—
Land	—	—	16,909.247	—
	7,230.717	79,829.350	87,060.067	87,060.067
B.—Widening Ibrahimiyah Canal.				
Earthwork	—	—	11,148.960	—
Revetment	—	—	2,758.000	—
Masonry works	—	—	10,846.029	—
Inspection houses	—	—	730.613	—
Land	—	—	2,588.080	—
	3,406.173	24,665.509	28,071.682	28,071.682
C.—Conversion of Minia Basins.				
Diversion of Bahr Yousef :—				
Earthwork	—	—	10,158.849	—
Land	—	—	163.463	—
Collection of materials	—	—	5,000.000	—
	—	15,322.312	15,322.312	15,322.312
D.—Etsa Pumping Station.				
1st Payment for plant	—	—	4,002.601	—
Building materials	—	—	900,000	—
	—	4,902.601	4,902.601	4,902.601
Carried forward...	10,636.890	124,719.772	135,356.662	135,356.662

General Abstract of Expenditure on "Special Works" charged to Special Caisse Credit and Special Grant from Ordinary Budget (*concluded.*)

Name of Work.	Expenditure.			
	Ordinary Budget.	Caisse Credit.	Total.	Total per work.
	£E.	£E.	£E.	£E.
Brought Forward...	10,636.890	124,719.772	135,356.662	135,356.662
E.—Establishment.				
Salaries	—	—	6,606.601	—
Travelling allowance, railway fares, etc. ...	—	—	1,228.690	—
Rent of buildings, Dahabiahs, materials for surveys and sundries	—	—	1,217.818	—
	3,203.108	5,850.001	9,053.109	9,053.109
Total, Projects Circle...	13,839,998	130,569.773	144,409.771	144,409.771
5th CIRCLE				
Hamad Escape and contingent works	381.000	15,089.177	15,470.177	15,470.177
Three feeder culverts and one escape	1,085.199	—	1,085.199	1,085.199
Total, 5th Circle...	1,466.199	15,089.177	16,555.376	16,555.376
Girga Directorate.				
Talihat Regulator, Sohaguia Canal	178.745	8,035.923	8,214.668	8,214.668
Head regulators for Kom Badr, Harabha, Beni Harb and Soffeiha canals	1,321.255	2,007.216	3,328.471	3,328.471
Earthwork and land...	—	456.861	456.861	456.861
Total, Girga Directorate...	1,500.000	10,500.000	12,000.000	12,000.000
Grand Totals...	38,846.197	317,718.540	356,564.737	356,564.737

APPENDIX G.

LIST OF MASONRY WORKS EXECUTED UNDER "SPECIAL WORKS" GIVEN IN APPENDIX F.

NAME OF WORK.	COST.		
	Per Work.	Total.	Total per Project.
	£E.	£E.	£E.
A.—WEST OF YUSUFI PROJECT.			
Regulator and lock, Nazlet El Abid (ironwork)	475.000		
Regulator Saqula (part payment)	6,920.605		
		7,395.605	
Additions to floor of Shushah Regulator...	968.303		
Inspection house at Saqula	500.000		
		1,468.303	
B.—CONSTRUCTION OF MAZURAH REGULATOR AND LOCK.			8,863.908
Regulator and lock (part payment)	29,513.817		
Inspection house	710.873		
		30,224.690	30,224.690
C.—EXTENSION OF WEST MOHIT DRAIN.			
Tail escape	3,353.332		
Purchase of pipes for syphon to pass west canal of converted basin	928.737		
		4,282.069	4,282.069
D.—WALIDIYAH SYPHON.			
Part payment for W.I. pipes	1,500.000		
		1,500.000	1,500.000
E.—MAGNUNA SYPHON (MAGNUNA CANAL).			
Part payment for W.I. pipes	450.000		
		450,000	450.000
F.—FAYUM REMODELLING WORKS.			
Canals.			
Hassan Wassif Canal, head sluice	3,420.000		
" " " four road bridges...	2,024.839		
" " " tail escape	603.825		
Bahr Nezleh :—		6,048.664	6,048.664
Difinu Regulator and two head sluices	1,515.000		
Tagin Aqueduct (part payment)	1,550.000		
Basil bridge	479.592		
Malahat Magoon culvert	90.000		
Carried forward...	3,634.592	—	51,369.331

List of Masonry Works executed under "Special Works" given in Appendix F (*cont.*)

Name of Work.	Cost.		
	Per Work.	Total.	Total per project.
	£E.	£E.	£E.
Brought forward...	3,634.592	6,048.664	45,320.667
Three road bridges	1,800.000		
Nasbah Mokrany...			
Syphon under Bahr Nezleh			
Four culverts for distributaries	200.000		
Branches of Bahr Nezleh :—			
Two falls on Bahr Monghany	1,095.222		
Three falls on Bahr Kasr-el-Gebali			
Nasbah Batn Hirit			
Head of left Ghanabiyah, Bahr Kasr Banat 2nd reach			
		6,729.814	
Minor Projects.			
Government share of combined road and light railway bridges	1,100.000		
Metartaris Alam Project :—			
Seventeen petty masonry works	1,506.000		
		2,606.000	
Drains.			
Thirty-three petty works, Tagin drainage system...	3,725.000		
		3,725.000	
Inspection Houses.			
Houses at Tamiyah, Seilah and Abuxa	1,082.095		
		1,082.095	
			20,191.573
PROJECTS CIRCLE.			65,512.240
A.—Conversion of Asyut Basins.			
Eleven regulators	3,873.860		
Two escapes...	1,199.583		
Two syphons...	3,315.798		
Eight falls	1,170.318		
Seventy-three head sluices...	8,643.678		
Fifty-three road bridges	7,451.208		
Irrigation outlets...	1,739.000		
Temporary drainage inlets...	276.550		
Four inspection houses	4,089.315		
		31.759,310	
Carried forward...	—	31,759.310	65,512.240

List of Masonry Works executed under "Special Works" given in Appendix F (*concl.*)

Name of Work.	Cost.		
	Per Work.	Total.	Total per project.
	£E.	£E.	£E.
Brought forward...	—	31,759.310	65,512.240
B.—Widening Ibrahimiyah Canal.			
Remodelling Minia Regulator	1,000.000		
New Hafiz Regulator...	5,103.743		
Four head sluices	2,653.924		
Feshn road and Daira Sanieh railway bridge	2,055.707		
Hafiz inspection house	730.613		
		11,543.987	
D.—Etsa Pumping Station.			
Part payment for plant and materials	4,902.601		
		4,902.601	
Total, Projects Circle... ...	—	48,205.898	48,205.898
5th CIRCLE.			
Hamad Escape and railway bridge	13,250.000		
Three feeder culverts	667.980		
One basin escape	333.891		
Total, 5th Circle... ...	—	14,251.871	14,251.871
GIRGA DIRECTORATE.			
Talihat Regulator, Sohagiya Canal	8,214.668		
Four head regulators for branches of Sohagiya Canal... ...	3,238.471		
Total, Girga Directorate... ...	—	11,543.139	11,543.139
Grand Total...	—	—	139,513.148

APPENDIX H.

List of New and Remodelled Banks and Channels executed under "Special Works" given in Appendix F.

Name of Work.	Length in kilometres.	Quantity of earthwork.	Cost.	
			Per work.	Total.
		C.M.	£E.	£E.
4th CIRCLE.				
A.—West of Yusufi Project.				
Banks.				
Saqula salibas and Yusufi sadd	1·040	71,420	1,500.000	1,500.000
B.—Mazurab Regulator.				
Banks.				
Mazurab Salibah	1·500	64,033	1,672.528	1,672.528
C.—Extension of West Mohit Drain.				
Part payment for excavation...	Incomplete.	90,000	1,000.000	1,000.000
F.—Fayoum Remodelling Works.				
Channels.				
Hassan Wassif Canal	14·000	1,010,967	48,458.056	
,, ,, Branches..	9·881	64,135	2,142.221	
Bahr Nezlah Remodelling.				
1st reach rock-cutting	4·500	41,242	6,392.510	
2nd ,, earthwork...	19·000	333,637	9,700.000	
Branches.				
2nd reach, Bahr Kasr Banat	13·000	110,007	7,386.296	
3rd ,, (part payment)	7·800	22,000	300.000	
Metartaris Alam Project (part payment) ...	20·400	160,000	2,080.687	
Remodelling Bahr Seilah..	4·000	168,750	2,700.000	
Tagin drains (part payment)	30·600	681,875	8,457.640	
	123·181	2,592,613	87,617.410	87,617.410
Total banks, canals & drains, 4th Circle ...	125·721	2,818,066	91,789.938	91,789.938

LIST OF NEW AND REMODELLED BANKS AND CHANNELS EXECUTED UNDER "SPECIAL WORKS" GIVEN IN APPENDIX F.—*concluded.*

NAME OF WORK.	Length in kilometres.	Quantity of earthwork.	COST.	
			Per work.	Total.
		C.M.	£E.	£E.
Brought forward	125·721	2,680,295	—	91,789.938
A.—CONVERSION OF ASYUT BASINS.				
Channels.				
Canals...	70·600	2,680,295	36,548.220	36,548.220
Distributaries	179·600			
Drains...	127·100			
B.—WIDENING IBRAHIMIYAH CANAL	16·000	443,328	11,148.960	11,148.960
Total banks, canals, drains, Projects Circle...	392·700	3,123,623	47,697.180	47,697.180
GIRGA DIRECTORATE.				
Head junction, Beni Harb Canal	1·761	38,393	393.528	393.528
5TH CIRCLE.				
Approach and out-fall channels, Hamad Escape	1·044	65,415	1,431.416	1,431.416
Grand Total	521·226	6,045,497	—	141,312.062

APPENDIX K.

REVETMENT OF BASIN BANKS WITH STONE.

PROVINCES.	LENGTH REVETTED.			QUANTITY AND COST OF STONE USED IN REVETMENT IN 1900.									Stone collected for use in 1902.	
	Previous to 1901.	In 1901.	To end of 1901.	Quantity collected in 1900.	Quantity collected in 1901.	Total quantity.	Quantity per lineal metre.	Cost of stone collected in 1900.	Cost of stone collected in 1901.	Total cost.	Cost per lineal metre.	Quantity.	Cost.
	M.	M.	M.	C.M.	C.M.	C.M.	C.M.	£E.	£E.	£E.	£E.	C.M.	£E.
4TH CIRCLE.													
Beni Suef	30,356	5,800	36,156	15,220	—	15,220	2·62	2,730.000	761.000	3,491.000	0·602	—	—
Minia	27,642	30,421	58,063	28,518	22,381	50,899	1·67	5,551.000	12,861.000	18,412.000	0·605	3,500	1,244.000
Asyut North	53,223	904	54,127	—	2,018	2,018	2·23	690.000	690.000	690.000	0·763	—	—
Total...	111,221	37,125	148,346	43,738	24,399	68,137	1·83	8,281.000	14,312.000	22,593.000	0·608	3,500	1,244.000
GIRGA DIRECTORATE													
Girga	45,041	1,118	46,159	1,717	2,322	4,039	3·61	421.000	566.000	987.000	0·882	—	—
Asyut South	46,834	585	47,419	—	1,633	1,633	2·79	—	446.000	446.000	0·763	—	—
Total...	91,875	1,703	93,578	1,717	3,955	5,672	3·33	421.000	1,012.000	1,433.000	0·841	—	—
5TH CIRCLE.													
Kena	—	—	—	—	—	—	—	—	—	—	—	—	—
Aswan	61,135	4,096	65,231	—	5,850	5,850	1·43	—	1,312.094	1,312.094	0·320	—	—
Total...	61,135	4,096	65,231	—	5,850	5,850	1·43	—	1,312.094	1,312.094	0·300	—	—
Grand Total...	264,231	42,924	307,155	45,455	34,204	79,659	1·85	8,702.000	16,636.094	25,338·094	0·590	3,500,000	1,244.000

APPENDIX L.

STATEMENT SHEWING DATES ON WHICH THE PRINCIPAL EVENTS OF "SARF" OCCURRED IN THE 4TH CIRCLE DURING 4 YEARS.

NOTE.—Special measures had to be taken in the low flood of 1899 and the usual programme could not be followed, consequently dates for that year are not given.

PROVINCE.	1897	1898	1900	1901	REMARKS.
ASYUT PROVINCE.					
Feeders from Ibrahimiyah Canal closed—to basin on west	8th Oct.	8th Oct.	1st to 2nd Oct.	Before 15th Sept.	Except feeders to Hod Delgani which were closed from 6th to 12th October, 1901.
Gebel Asyut bridge nearly closed...	8th Oct.	8th Oct.	8th Oct.	8th Oct.	
Cut made in tarrad of Hod Itqa	13th Oct.	14th Oct.	Not made.	Not made.	
Cut made in Salibah Beni Khalid	10th Oct.	11th Oct.	10th Oct.	Partially 13th Oct. Fully 15th Oct.	A regulator has been built in place of cut. Dates of opening regulator.
Delgawi and Badraman escapes opened ...	9th Oct.	10th Oct.	9th Oct.	10thO.to1stN.	Delgani escape had to be opened in 1901 very gradually. Badram opened 23rd to 28th October.
Cut made in tarrad of Hod Ashmunin ...	11th Oct.	13th Oct.	10th Oct.	Not made.	Hod Ashmunin converted to Sefi before flood of 1901.
Um Afrita Regulator opened...	11th Oct.	18th Oct.	9th Oct.	Not opened.	This bridge is in Salibah of Hod Ashmunin which has been converted to Sefi.
Sabakhah Canal head closed	17th Oct.	17th Oct.	12th Oct.	21st Oct.	
Supply in Bahr Yusuf reduced by closing head at Deirout	18th Oct.	17th Oct.	14th Oct.	10th to 17th Oct.	
MINIA PROVINCE.					
Cut made at south end of Tarrad Hod Tanashawi	8th Oct.	Cut open.	Not made.	23rd Aug.	This cut made to feed Hod Tanashawi from Yusufi in place of Itqa Canal in Hod Itqa, converted to Sefi before flood of 1901.
Abu Ismail bridge, Salibah Tanashawi, opened	12th Oct.	14th Oct.	15th Oct.	13th Oct.	
Talata and Sabâah bridges in Salibah Tanashawi opened	12th Oct.	14th to 15th Oct.	12th to 15th Ot.	13th Oct.	
Zanuba and Nezlet El Abid escapes, Hod Tanashawi, opened	12th Oct.	14th Oct.	Partially 12th Oct. Fully 15th Oct.	13th to 14th Oct.	
1st cut made in Tarrad Hod Tanashawi ...	12th Oct.	14th Oct.	Not made.	Not made.	No longer required, now that West of Yusufi system of basins have been completed.
2nd " " " ...	12th Oct.	—	Not made.	Not made.	
1st " " " El Qurn... ...	12th Oct.	14th Oct.	14th Oct.	Not made.	
2nd " " " "	12th Oct.	—	15th Oct.	Not made.	
Regulator in Salibah Tahaw opened	12th Oct.	15th Oct.	17th Sept.	13th Oct.	
Cut made in Tarrad Hod Tahaw	14th Oct.	—	16th Oct.	14th Oct.	
Cut made in Tarrad Hod Deri	13th Oct.	15th Oct.	16th Oct.	17th Sept.	
Regulator in Salibah Deri opened	13th Oct.	17th Otc.	17th Oct.	19th Oct.	
" " " Manqatin opened ...	13th Oct.	16th Oct.	19th Oct.	21st Oct.	

	Cut made in Tarrad Hod Manqatin ”	13th Oct.	—	19th Oct.	Not made.	
	” ” ” Membal	14th Oct.	—	25th Nov.	Not made.	
	El Gamal Escape opened	14th Oct.	17th Oct.	28th Oct.	Not opened.	In 1901 the Yusufi was very high and El Gamal could not be opened in sarf time.
	Regulator in Salibah El Qurn opened	12th Oct.	15th Oct.	19th Oct.	10th Oct.	
	Regulator in Salibah Garmusi opened	14th Oct.	17th Oct.	21st Oct.	28th Oct.	
	Abu Rahib Escape opened in Salibah Salaqusi	15th Oct.	17th Oct.	21st Oct.	28th Oct.	
	West of Yusufi, Minia Province.					
South System.	Nezlet El Abid Regulator fully opened .	Not built.		9th Oct.	13th to 14th Ot.	
	Cut made in Salibah Nezlet El Abid ...	Not in existence.		12th Oct.	16th Sept.	In 1901 a breach occurred on 16th September which was left open to assist in filling basin of South System.
	Regulator in Salibah Tukh opened ...	”		16th Oct.	14th Oct.	
	Escape from Hod Tukh on to Yusufi op.	”		Not opened.	14th Oct.	
	Cut made in Salibah Qamadir	14th Oct.	16th Oct.	13th Oct.	Not made.	
	Regulator in Salibah Qamadir opened...	Not built.	15th Oct.	27th Oct.	16th Oct.	
	Cut made in Salibah Shushah—Regulator built before flood of 1898	14th Oct.	16th Oct.	17th Oct.	18th Oct.	Date of opening regulator since 1898.
	Regulator in Salibah Terfa opened ...	Not built.	17th Oct.	24th Oct.	19th Oct.	
	Escape from Hod Terfa on to Yusufi op.	Not in existence.		Not opened.	18th Oct.	
	Regulator in Salibah El Der opened ...	Not built.	18th Oct.	20th Oct.	20th Oct.	The date given for 1898 is that of cut made in salibah before regulator was built.
North System.	Saqula Regulator fully opened	Not built.			21st Oct.	Finished in 1901 but too late to be used that year.
	Regulator in Salibah Bartobat opened ...	Not built.		25th Oct.	25th Oct.	
	” ” Qayat ” ...	”		18th Oct.	25th Oct.	
	Cut made in Salibah Hariqap—replaced by regulator in 1899	17th Oct.	19th Oct.	19th Oct.	24th Oct.	
	Cut made in Salibah Shenarap—replaced by regulator in 1899	17th Oct.	19th Oct.	After Sarf.	24th Oct.	
	Escape of Hod Shenarah opened	Not built.		23rd Oct.	22th Oct.	Opened in 1901 on 22nd October before Shenarah had reached T.R. level to try and get a draw through North System of basins to relieve high level in Yusufi at Saqula.
	” ” Delhanes ”	”		23rd Oct.	27th Oct.	
	BENI SUEF PROVINCE.					
	Mazurah Regulator fully opened	Not built.			27th Oct.	
	Regulators in Salibah Sultani opened	22nd Oct.	19th Oct.	26th Oct.	29th Oct.	
	” ” Nina ”	23rd Oct.	20th Oct.	1st Nov.	30th Oct.	
	” ” Nuera ”	24th Oct.	19th Oct.	31st Oct.	1st Nov.	
	” ” Bahabshin opened ...	Not in existence.		30th Oct.	2nd Nov.	
	Escape in tarrad of Hod Nina—record previously as a cut in tarrad	26th Oct.	19th Oct.	1st Nov.	9th Nov.	
	Upper gates of Koshesha escape released ...	20th Oct.	18th Oct.	Not opened.	5th to 8th Nov.	
	Lower ” ” ” opened ...	—	—	Partially 28th Oct. Fully 3rd Nov.	10th to 23rd Nov.	
	Attwab escape opened	19th Oct.	19th Oct.	After sarf.	11th, 13th Nov.	
	Komi Regulator opened	?	?	?	Partially 25th Oct. Fully 19th Nov.	

APPENDIX M.

STATEMENT SHOWING THE AREA UNDER DIFFERENT CROPS IN THE PROVINCES, UPPER EGYPT, INCLUDING GOVERNMENT AND WAKF'S LAND AND LAND OF THE DAIRA SANIEH AND DOMAINS, FROM THE COMMENCEMENT OF THE FLOOD OF 1900 TO THAT OF 1901.

PROVINCE.	Total area, taxed and untaxed.	Waste land "Bour."	Total area of crops.	Area double cropped.	Area of cultivated land.	NILI CROPS.			WINTER CROPS.					SEFI CROPS.					Gardens.
						Maize, Durah, Nabari, Shami and Sorghum.	Rice.	Total, Nili crops.	Wheat.	Beans.	Barley.	Others.	Total, winter crops.	Cotton.	Sugar-cane.	Maize and Sorghum.	Vegetable.	Total, Sefi crops.	
	FED.	FED.	FED.	FED.	FED.	FED.	FED.	FRD.	FED.	FED.	FED.	FED.	FED.	FED.	FED.	FED.	FED.	FED.	FED.
Beni Suef	281,445	3,962	277,483	33,870	243,613	30,940	—	30,940	74,400	66,589	21,369	44,989	207,347	23,763	5,994	7,804	1,379	38,940	256
Fayum	559,865	85,889	473,976	117,826	356,150	148,232	24,920	173,152	68,401	67,192	26,853	89,148	251,594	42,826	628	54	2,991	46,499	2,731
Minia	489,310	39,796	419,514	24,691	424,823	63,366	41	63,407	90,801	100,482	23,030	98,563	312,877	22,216	36,410	11,989	2,096	72,711	519
Asyut	481,115	11,185	469,930	34,655	435,275	31,626	—	31,626	134,813	127,316	12,576	109,090	383,795	2,920	12,330	35,250	2,524	53,024	1,485
Girga	385,252	1,915	383,337	51,434	331,903	26,427	—	26,427	107,624	67,569	43,794	99,113	318,100	4	3,884	32,615	695	37,198	1,612
Kena	439,081	11,040	428,041	65,089	362,952	60,651	—	60,651	99,383	41,302	60,864	119,965	321,514	86	17,529	25,090	2,094	44,799	1,077
Aswan	84,176	4,258	79,948	2,032	77,886	28,517	—	28,517	15,030	4,116	16,556	9,059	44,761	—	518	2,482	2,363	5,363	1,277
Total.. ..	2,720,244	158,045	2,562,199	329,597	2,232,602	—	—	414,720	—	—	—	—	1,839,988	—	—	—	—	298,534	8,957
Column	A	B	C	D	E			F					G					H	K

NOTE : A=B+C and C=F+G+H+K.
C=D+E

APPENDIX S.

TABLE I.—Statement showing the quantity of Sugar-cane crushed in the Daira Sanieh Factories in Middle and Upper Egypt in Season 1900-1901 and the amount of No. 1 Sugar produced.

Name of Factory.	Cane crushed in kantars.	Outturn of No. 1 Sugar in kantars.
MIDDLE EGYPT.		
Biba	1,211,685	113,298
Maghaghah	1,796,278	167,899
Matai	1,268,597	122,991
Minia	1,663,256	166,543
Abu Qirqas	1,594,886	167,395
Roda	2,114,307	223,623
Total, Middle Egypt	9,649,009	961,749
UPPER EGYPT.		
Dabaiyah	991,602	99,070
Armant...	917,496	94,068
Mata'anah	884,345	90,956
Total, Upper Egypt	2,793,443	284,094
Grand Total	12,442,452	1,245,843

APPENDIX S—*continued.*

TABLE II.—SUGAR-CANE CRUSHED AND SUGAR OUTTURNED BY THE DAIRA SANIEH FACTORIES DURING THE LAST TWENTY-THREE YEARS.

Factory season.	From crop of.	Quantity of cane crushed in kantars.	Total sugar produced in kantars.	Nature of summer level preceding factory season.	REMARKS.
1880	1879	8,402,833	605,623		The total sugar produced includes the three qualities Nos. 1, 2, and 3.
1881	1880	2,365,642	182,096		
1882	1881	7,336,192	603,225		
1883	1882	4,880,094	422,622	Unfavourable.	
1884	1883	8,445,247	667,451	Favourable.	
1885	1884	9,918,201	854,884	Very favourable.	
1886	1885	11,258,057	973,500	Fair.	
1887	1886	10,986,224	934,376	Favourable.	
1888	1887	10,411,640	961,352	Favourable.	
1889	1888	8,382,837	790,197	Fair.	
1890	1889	7,602,302	695,870	Very favourable.	
1891	1890	11,130,799	1,149,893	Very low.	
1892	1891	12,522,918	1,329,627	Low but early rise.	
1893	1892	12,755,107	1,207,164	Low and late rise.	
1894	1893	14,253,813	1,427,608	Very favourable.	
1895	1894	14,601,832	1,385,345	Favourable.	
1896	1895	15,217,050	1,564,972	Very favourable.	
1897	1896	13,253,433	1,882,979	Very favourable.	
1898	1897	12,369,140	1,176,067	Very favourable.	
1899	1898	11,636,689	1,173,871	Low.	
1900	1899	12,680,860	1,340,983	Very favourable.	
1901	1900	9,680,482	1,057,902	Very low but early rise.	
1902	1901	9,649,009	1,081,967	Very low rise early, but feeble.*	

*This is calculated from No. 1 Sugar produced by adding one-eighth to allow for Nos. 2 and 3 Sugar, i.e.:—

	Kantars.
No. 1 Sugar	961,749
Nos. 2 and 3 Sugar	120,218
Total...	1,081,967

APPENDIX S—*continued.*

TABLE III.—SUGAR-CANE CRUSHED AND SUGAR OUTTURNED IN SULTAN PASHA'S FACTORY AT DAMARIS DURING THE LAST NINETEEN YEARS.

Factory Season.	From crop of	Quantity of cane crushed in kantars.	Total sugar produced in kantars.	REMARKS.
1884	1883	258,855	23,199	The total sugar produced includes the three qualities Nos. 1, 2, and 3.
1885	1884	258,405	24,720	
1886	1885	250,426	23,705	
1887	1886	272,984	23,903	
1888	1887	274,549	23,636	
1889	1888	276,505	24,648	
1890	1889	266,218	23,783	
1891	1890	228,421	31,609	
1892	1891	382,791	36,161	
1893	1892	442,187	37,275	
1894	1893	471,076	40,253	
1895	1894	545,274	47,429	
1896	1895	541,202	51,954	
1897	1896	587,462	59,543	
1898	1897	451,390	40,566	
1899	1898	479,822	48,761	
1900	1899	466,027	46,732	
1901	1900	524,466	54,966	
1902	1901	410,465	44,700	

This is calculated from No. 1 Sugar produced by adding one-ninth to allow for Nos. 2 and 3 Sugar, i.e.—

	Kantars.
No. 1 Sugar	40,230
Nos. 2 and 3 Sugar	4,470
Total.	44,700

NOTE:—The one-ninth allowed for Nos. 2 and 3 Sugar is the same proportion as used in former years and has been to for purposes of comparison: the actual proportion, is, however, as much as one-seventh.

APPENDIX S—*concluded.*

TABLE IV.—Statement showing the quantity of Sugar-cane crushed in the Factories of the "Société Générale des Sucreries de la Haute-Egypte" and the quantity of No. 1 Sugar produced during the past six years.

Season.	Factories.						Total.	
	Naga Hamadi.		Shekh-Fadl.		Hawamdiyah.			
	Cane crushed in kantars.	Outturn of No. 1 Sugar in kantars.	Cane crushed in kantars.	Outturn of No. 1 Sugar in kantars.	Cane crushed in kantars.	Outturn of No. 1 Sugar in kantars.	Cane crushed in kantars.	Outturn of No. 1 Sugar in kantars.
1896-1897	644,438	68,888	1,822,204	191,109	1,333,320	135,554	3,799,962	395,551
1897-1898	1,661,418	108,870	2,782,670	238,574	654,808	56,990	5,098,896	409,434
1898-1899	1,776,825	173,263	3,158,415	304,949	1,315,080	125,790	6,250,320	604,002
1899-1900	1,618,341	168,252	3,169,252	301,191	1,191,278	105,641	5,978,871	575,409
1900-1901	—	—	—	—	—	—	6,908,772	682,587
1901-1902	3,231,460	265,600	3,505,617	283,164	916,471	94,067	7,653,548	* 642,813

*Method of classification appears to have been altered, owing to which the percentage of No. 1 Sugar has been reduced.

ADMINISTRATION REPORT

OF THE

IRRIGATION DEPARTMENT IN LOWER EGYPT

For 1901

BY

MAJOR R. H. BROWN, C.M.G.,

INSPECTOR-GENERAL OF IRRIGATION IN LOWER EGYPT.

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ADMINISTRATION REPORT OF THE IRRIGATION DEPARTMENT IN LOWER EGYPT FOR 1901.

CHAPTER I.

WINTER, SPRING AND SUMMER IRRIGATION.

When the poor flood of 1900 subsided, the country was left with the disquieting prospect of another summer of short supply before it. The river levels of the 1st January 1901 were, at Aswan, 67 centimetres lower than the mean of twenty years, but higher by a metre than those of the same date of the year before, which was notable for the shortest summer discharges on record. Nevertheless, there was not wanting a prophet of evil, with claims to be heard, to encourage depression by his prediction that the summer that was coming would prove to be the worst of all bad summers as regards the Nile discharges; for, he argued, the critical situation of the year before was saved by the cutting of the "Sadd" and the consequent release of impounded water, whereas there was no store of impounded water left for salvation in 1901. Notwithstanding these dismal forebodings, there was no alarm felt in the country such as was general and acute the year before. The most probable explanation of this change in the mental attitude of the public is that the experience of the year before, when a cotton crop of 5½ milion kantars was secured under conditions so severe as to give rise to the alarm, had created a feeling of confidence which was not to be shaken by the voice of the prophet of evil, especially as the basis of his argument was not accepted as fact. The summer levels were low, but not so low as the year before. But low though they were, the yield of the cotton crop of 1901 is expected to be not less than 6½ million kantars of cotton, and may even beat all previous records.

The minimum readings of the years 1900 and 1901 follow:—

GAUGE STATION	1900		1901	
	Date.	Readings.	Date.	Readings
Khartoum	26th to 29th March.	— 0·42	16th to 18th April.	— 0·08
Berber *	4th May (?)	0·41 (?)	15th April.	0·63
Halfa	9th and 10th May.	0·89	2nd and 3rd May.	1·04
Aswan...	15th and 16th May.	84·07	6th to 10th May.	84·54
Barrage, upstream	12th June	12·92	1st Minimum 20th to 25th May.	13·62
			2nd Minimum 26th June.	13·58

The winter, as usual, passed without difficulty. Favourable levels were produced by regulation on the Barrage in February to meet the sudden demand that is always made during that month for the irrigation of winter crops after the general canal closures for clearance, and for the simultaneous preparation of land for cotton sowings.

In the interests of the summer crops the same measures as the year before were adopted with the object of utilising and making the most of all possible resources. Dams were made on the two branches of the Nile near Damietta and Rosetta to keep out the sea-water and allow the pumps above them to work: rotation programmes were carefully prepared, and a Decree was obtained giving the Minister of Public Works power to forbid the employment of water for the preparation of the ground for Maize sowings until such date as he might decide permission could safely be given.

The general rotation programmes were drawn up so as to allow for a watering every twenty-one days. It was found to be the most convenient arrangement to divide the Irrigation Circles or Provinces into three sections, each of which in rotation was allowed to take water for seven days, and was forbidden to take it for the succeeding fourteen days. The programmes had been prepared for application from 7th April, but it was found unnecessary to enforce them until the 17th May, when the upstream level of the Barrage was at R.L. 13·64.† For some time after this date it was found that there was more than enough water for one section alone; and, for this reason, the section, whose turn to take water would come next, was allowed to work for three days before its proper turn, and to use up any water that there might

---

* Gauge at Berber not actually erected and read till a few days after the date of lowest level.

† In 1900 rotations began on 14th April with the Barrage level at R.L. 13·33.

be to spare. By this arrangement water was at first supplied for ten days out of twenty-one; but, as the summer advanced and the heat increased, while the available quantity of water decreased, the supply gradually dwindled to the normal seven days out of twenty-one, and in some cases to less than that.

As this system, which was applied to the whole of Lower Egypt, was based on the experience of all preceding years and was adopted by the common consent of the principal Irrigation Officials of the Delta; and as, moreover, it has stood the test of practical application with satisfactory results, it is worth while describing in more detail how the system was worked in practice.

The three-section programme is adapted only to cotton areas: where rice is grown, a two-section programme, giving five days' supply and six days' non-supply, has to be substituted. Each section has five days' supply, and one day's general stoppage occurs at the end of the upper section's period of supply to allow for the canal in the lower section filling up before any water is drawn from it. Early in 1901 it was decided, at a meeting of officials concerned, that the river supply was not sufficient to provide for rice being grown universally in the usual rice regions; but it was thought advisable to make such dispositions as would allow of its being grown in certain localities, selected on account of the possibility of applying special programmes to them without upsetting the general programmes best adapted to cotton areas and most conducive to economy in the use of the water. The tracts selected for favouring rice planting are detailed below:—

1st Circle.—Lands watered by the Ismailia Canal in the Sharkia Province. Lands watered by Canals Ekiad, Saidia Junction, Ganabia Salhia and Saarana, also in Sharkia Province. Lands watered by the Bahr Tanah in Dakahlia Province.

2nd Circle.—Lands watered by the Bahr Saidi and canals to the north of it, namely, the tail of the Qodaba Canal, Yusuf Eff. Canal, Rashidia Canal and Khalig Birimbal.

3rd Circle.—Lands watered by the Mahmudia and Rosetta Canals.

The 2nd and 3rd Circles tracts were chosen on account of the facilities for irrigation produced by the action of the Mehallet-el-Amir Dam, to be described hereafter.

Pumps drawing direct from the Nile were not subjected to rotations, so that they also were available for the irrigation of rice, if their owners chose so to use them.

The canals, whose function it was to irrigate cotton only, were divided into three nearly equal sections—A, B and C—A section being at the head. Each section was accorded its own week of supply, when it had first claim on what water there might be. If, however, there was any excess passing section A during its week of supply and entering B section, the latter was allowed to make use of it during the last three days of A's week, but B had no *claim* to water for these three days : it was only allowed to make use of A's excess, *if* there happened to be any. The same arrangement was made for B and C during B's week, and for C and A during C's week. During A's and B's weeks no harm could come of this arrangement, as the excess had to pass the upper section before it could be used by the lower. But this security did not exist for C, in that A, being higher up the canal, got first pull at the water. It was, therefore, necessary to be cautious in giving A permission to work during C's week, in order that C might not have its supply reduced below its proper share by the effect of pumps of A section working. Otherwise the system was automatic.

By the end of June there was no excess, and each section got no more than its seven days' supply. The river discharge was not even sufficient to give this fully, and it frequently happened that some fields got no water during their established week. On complaints being received of such instances of failure to get irrigated, the facts were verified, and, if confirmed, the unwatered fields were irrigated during the following section's week. After the middle of June these added arrears of the preceding section's period increased in extent weekly, and threatened to throw the programme into unmanageable confusion. This, however, was avoided ; but the strain experienced was sufficient to demonstrate that the available supply was not ample enough to give a watering in twenty-one days ; but that it would have made the programme work more smoothly, if, when this was the case, the intervals between waterings had been lengthened so as to give a watering in twenty-four days instead of twenty-one.

The difficulties of distribution are greatest during July, in spite of the steady increase in the river which then begins. The demand in early July becomes intense and out-strips the river increase, so that there is danger of the weekly arrears producing confusion. In July, 1901, the rising river had not succeeded in righting matters before the "Sharaki" prohibition was removed on July 12th, making it exceedingly difficult in some cases to recover lost ground. But somehow or other the cotton was all watered and the maize sown in good time. Still it would probably have been better, if, from the beginning or the middle of June, a day's general non-supply had been inserted between each section's working, so as to increase the intervals between waterings and allow a watering in twenty-four days. The days of general non-supply are most useful aids to dealing with the arrears and preventing them accumulating to the extent that overwhelms.

It was further realised, when it was too late, that the "Sharaki" prohibition should not have been removed for a week later than it was. The mistake was made through anxiety to permit the sowing of the maize crop on the earliest date possible. The sowing, however, can wait without any risk of harm till 20th July. The maize crop of 1901 is reported to have been an excellent one for the second year in succession, in spite of the operation of the Decree controlling the time of its sowing.

The minimum level above the Barrage of R.L. 13·58 was reached on 26th June. There was then a gradual rise to R.L. 14·00 by the 12th July, followed by a more rapid rise to R.L. 15·50, which level was reached on 22nd July. This level was maintained till the gradual opening of the Barrage was complete on 19th August.

"Rotations" ceased to be enforced from the following dates :—

1st Circle.		
	Ismailia Canal	27th July.
	Qaliubia Province	12th August.
	Sharkia "	9th "
	Dakahlia "	5th "
	B. Saghir	15th "
2nd Circle.		
	Menufia and Gharbia Provinces	17th "
3rd Circle.		
	S. Behera	9th "
	Mahmudia	10th "

The Atfeh pumps worked intermittently till 15th August, when they were finally stopped.

Mr. Dupuis draws attention to a noteworthy fact about rice-planting on the 2nd Circle canals which were so worked as to facilitate the growing of this crop. He notes that, in spite of the unprecedentedly good conditions of the water supply that resulted from the successful handling of the Mehallet-el-Amir dam, exceedingly little advantage was taken of the opportunities offered to plant rice, and he ascribes this to the fact that in 1900, when rice could not be sown and cotton was raised instead, the growers found cotton so profitable that they now prefer to grow cotton on any land where even a poor crop can be raised.

Mr. Williams also reports that the same failure to take full advantage of the facilities afforded for rice growing on the Mahmudia Canal was remarked, the area of Sefi (Sultani) rice being estimated at 10,472 feddans only.

It has been suggested, I cannot say with what foundation in fact, that the clamour for water to be given at frequent enough intervals to suit rice crops is mainly prompted by a desire to get more abundance of water for cotton in those distant parts of the Delta where the summer supply is most liable to fail at critical moments.

TEMPORARY DAMS ON THE DAMIETTA AND ROSETTA BRANCHES.

The dam on the Damietta branch was made in the usual place to the north of Damietta town. Together with certain contingent works of clearance and closure of channels in connection with it, the cost of this work was £E.4,746. In 1900 its cost was £E.4,936. It served its purpose in keeping out the salt water of the Mediterranean to the usual extent, but its position below Damietta is not favourable to the total exclusion of salt water from the reaches of the river above the dam. In the first place it is very near the sea; and, in the second, the deep holes formed in the river bed, where the river suddenly takes a right-angled turn at the upper end of the town of Damietta, collect the sea-water which, in consequence of its weight, finds its way into them as soon as the flood subsides, and there is no longer sufficient current to hold the sea-water back, but still too much to prevent the dam being made. In 1901 the dam was completely closed on 11th April, causing the river to rise at Damietta half a metre above sea-level. Later on, when the level above it was lowered by the effect of the extensive pumping that goes on higher up the river, the surface water got mixed with the salt water of the deep holes at Damietta and became unfit for drinking, and eventually unfit even for irrigation purposes. It is, therefore, the intention in 1902, to form the dam on this branch higher up the river a little to the north of Fareskur, and to adopt a similar method of working and using it as proved eminently successful in the case of the Mehallet-el-Amir Dam on the Rosetta Branch in 1901. It is not, however, expected to get as much advantage out of the Damietta Branch Dam as out of the Rosetta Dam, as the spring and percolation discharge of the Damietta Branch does not amount to so much as that of the Rosetta. But by keeping the reservoir above the dam full to as late a date as possible through feeding it from the Barrage or the Mansuria Canal whenever there is any possibility of sparing water, it is hoped that the supply of water in the river bed, on which the pumps along the banks depend, will not fail at the critical time of the year and force us to supplement the spring and percolation discharge by contributions from the canals at a time when water can least be spared.

The Rosetta Branch Dam was made as usual at Mehallet-el-Amir. On Mr. Dupuis' suggestion, the question of raising the dam higher than usual, so as to hold up two to two and a quarter metres of water, or a metre higher than in previous years, was considered. The advantages of so doing were that the water would be raised in the river to such a height that it would flow by gravitation into the Bahr Saidi and the canals to the north of it; and also, on the other side of the river, would flow into the Rosetta Canal. Further, the pumps at Atfeh and those along the river would work with a lower lift and, therefore, more efficiently and economically, and a large body of water would be stored to draw upon in case of need. The Caisse de la Dette had granted a sum of £E.3000 for the expenses of a temporary pumping station to be erected at the mouth of the Bahr Saidi, and worked to supply the canal with water from the river. By the rasing of the dam, as proposed, the difference between this sum and the cost of the additions to the dam would be economised, and this alone would have made it worth doing. The only question was—could the dam be made sufficiently strong in the time at our disposal to stand the head. It was calculated that there was time to do so, and the additional work was ordered. The crest of the dam was raised to a metre above the reservoir H.W.L. of R.L. 2·25 decided on, and the dam was given a crest-width of 2 metres with side slopes of 3 to 1, providing a width of 8 metres at H.W.L. The result was most satisfactory. A liberal supply of water was obtained for the Bahr Saidi and the canals to the north of it, which were those which had been selected for rice cultivation in the 2nd Circle. The same was the case with the Rosetta Canal on the other side of the river. All these canals had a better summer supply than they have ever had before, and the difficulty of supplying them, which had hitherto always been felt as a serious one, entirely disappeared. The draw of these canals kept the water-level above the dam constant, showing that the river supply due to springs and infiltration between the Barrage and Atfeh was just sufficient to feed them and supply the private pumps along the river. When, however, in July, the Government pumps at Atfeh were set to work, the water-level above the dam began to fall and the supply to the Bahr Saidi to become deficient. But the rise of the river put matters right before the deficiency had become serious.

The Mehallet-el-Amir Dam, thus developed, afforded great relief to the 2nd and 3rd Circles of Irrigation. The cost to make, maintain and remove was £E.8,187, whereas the dam of smaller dimensions and inferior performance of the year before cost £E.9,408. The construction of the dam was commenced on 10th January, 1901, and the closure effected by the end of March. The further raising of the crest to R.L. 3·25 and additions to the widths were complete by 24th May.

The improvement in the levels maintained at the tail of the Mahmudia was very satisfactory. The mean level in Alexandria during June, July and August 1901 was R.L. 1·82, a figure which is 80 per cent higher than the normal gauge for that season. The level never fell to R.L. 1·00, the minimum (which was that of the 23rd August) being R.L. 1·13 and lasting for one day only.

CROPS.

The cotton crop figures, since the Barrage restoration, are as below:—

Crop of	1891	 4,765,341	kantars.
„	1892	 5,220,510	„
„	1893	 5,033,235	„
„	1894	 4,619,233	„
„	1895	 5,256,128	„
„	1896	 5,879,479	„
„	1897	 6,566,487	„
„	1898	 5,583,306	„
„	1899	 6,440,625	„
„	1900	 5,474,299	„
„	1901	Probably not less than 6½	millions.*

The cotton crop area for 1901 is reported to have been 1,249,883 feddans, of which 105,318 were in Upper Egypt, and the rest in Lower Egypt. The mean yield is, therefore, about 5¼ kantars a feddan.

In 1901 cotton worm is stated to have affected the yield in the districts of Shubrakhit, Abu Hommos and Teh-el-Barud of the Behera Province.

The maize crop suffered nothing by the prohibition to plant it earlier than the 12th July: the harvest was a good one. In fact it is stated in Mr. Dupuis' Report to be universally admitted that the dura crops of 1900 and 1901 were of unusual excellence.

DUTY OF WATER.

The summer "duty" in Lower Egypt for 1901 is calculated from the discharges of the period between 5th May and 10th July inclusive,

*Latest information makes the probable figure 6,467,500.

which embraces the whole period of rotations until the date on which the planting of "dura" was permitted, and also the twelve days preceding the application of rotations. On 5th May the level above the Barrage was R.L. 13·87 : between 5th May and 10th July the level varied from R.L. 13·87 to R. L. 13·58: on the 10th July the level was again at R.L. 13·87 and rising steadily: the average level for the period selected was R.L. 13·71.

As rice planting in certain districts was allowed for in the preparation of the rotation programmes, the high "duty" of the summer of 1900, when no provision was made for rice cultivation, could not be again expected, since the economical distribution of water to the summer crops is much affected by the necessity of providing for the frequent waterings that rice requires, not only on the branch canals which irrigate the rice, but on the main canals also which have to feed those branch canals. The maximum "duty" of water to be obtained in the irrigation of summer crops can only be calculated with any approach to accuracy under such conditions as prevailed in 1900 when nothing but summer crops other than rice had to be provided for. We do not know how much rice takes: we allow in our calculations 40 cubic metres a feddan, but it is the general opinion that the cultivators succeed in obtaining much more than that; for it is certain they will take as much as they can get, and the rice areas are generally situated in the most remote regions where control is weakest.

When comparing the "duties" obtained below with the "duties" worked out in previous years, it must be remembered that, previous to 1900, no account was taken in the calculations of the addition to the available supply made by pumping below the Barrage. The figures now obtained are more in agreement with actual facts, but do not show such efficiency as the previous inaccurate calculations did.

I will first give the calculation of the duty separately by Circles and afterwards for Lower Egypt as a whole.

In the 1st Circle, four canals supply water to the crops, the Rayyah Taufiki and Canals Basusia, Sharkawia and Ismailia.

	Cubic metres.
The mean daily discharge of these four canals obtained from nine observations taken between 5th May and 10th July was	15,311,472
Estimated addition by river pumps	1,000,000
Total	16,311,472
Deduct for Port-Said and Suez town supplies...	11,472
Total available discharge	16,300,000

The crops, as given by the Finance, were—

Sefi rice	30,204 fed.
Cotton and Sefi crops other than rice	543,344 „
Deducting for rice at the rate of 40 cubic metres (30,204 × 40 = 1,208,160), the total available for cotton and sefi crops becomes	15,091,840 c.m.
and the general duty $\frac{15,091,840}{543,344}$	= 27·78 „

Mr. Langley works out his duty to have been 25·60, but he does not use the Barrage measured discharges. In the case of each Circle, I have used the discharges measured by the Barrage, and the areas given by the Finance Ministry.

The "duty" of water in the 2nd Circle is obtained by the following figures and calculation :—

Area of Sefi rice	14,708 fed.
Area of Sefi crops other than rice	495,100 „
Mean discharge of the R. Menoufia from 5th May to 10th July	11,335,341 c.m.
Estimated discharge of river pumps and Bahr Saidi supply.	2,000,000 „
Total available discharge	13,335,341 „
Deduct for Sultani rice 14,708 × 40	588,320 „
Balance available for the irrigation of cotton and other Sefi cultivation	12,747,021 „
Whence the general duty for Sefi crops other than rice is found to be	25·74 „

The following is the calculation of the "duty" of water in the 3rd Circle :—

Mean discharge of R. Behera from 5th May to 10th July		6,700,000 c.m.
Mean discharge of Afteh Pumps		72,000 „
Private pumps on river and direct flow from above Mehallet-el-Amir Dam (about)		500,000 „
Total available discharge		7,272,000 „
Deduct for Sultani rice 10,472 feddans × 40	= 418,880	
Deduct for Alexandria town supply 2,630,724 c.m. ÷ 67 days.	= 39,264	458,144 „
Balance available for the irrigation of cotton and other Sefi cultivation		6,813,856 „

The area of Sefi cultivation other than rice was 253,443 fed.

The "duty" was therefore $\frac{6,813,856}{253,443} = 26·89$ cubic metres per day per fed.

The "duty" for cotton and other Sefi crops, worked out with the same figures for the whole of Lower Egypt, is 26·82. Hence we find that the 3rd Circle received its fair share of water, the 1st Circle, as usual, received more than its share, while the 2nd Circle received less.

The total available mean supply for Lower Egypt, without making any deductions for rice or town supplies, was 34,918,813 cubic metres. The cultivated area of Lower Egypt is given by the Finance as 3,008,260 feddans. The general duty on the cultivated area is therefore 11·67 cubic metres. It was found by a calculation made in last year's report (p. 154) that, with no rice to provide for, nine cubic metres per feddan of cultivated area was the allowance required to permit of one watering every three weeks being given to "other Sefi crops."

It is interesting to compare the "duty" of water in terms of the cotton crop for the past two years, 1900 and 1901. The following calculation makes the comparison:—

	1900.	1901.
Mean available discharge, 5th May to 10th July	26,117,935	34,918,813
Deduct for Sefi rice	29,743 × 40 = 1,189,720	55,385 × 40 = 2,215,400
Balance discharge...	24,928,215 c.m.	32,703,413
Cotton crop	5,474,299	6,600,000 (estimated)
"Duty" per kantar of cotton.	$\frac{24,928,215}{5,474,299} = 4{\cdot}05$ c. m.	$\frac{32,703,413}{6,600,000} = 4{\cdot}95$ c.m.

Thus, assuming that 6,600,000 kantars is the correct figure for the 1901 crop, we find that, in 1900, a larger "duty" in terms of cotton was obtained. This must be due partly to the greater severity of the rotations in 1900, the intervals between waterings having been extended to twenty-eight days as against twenty-one in 1901; and also to greater economy of distribution being made possible by the exclusion of special rotations for rice. But the crop can only cover a certain proportion of the cultivable area, which is probably the chief cause limiting the total yield of the cotton crop in all but the worst years such as 1900, when, probably, the maximum duty was reached.

Lake Victoria Nyanza Gauges.

A study of the levels recorded in our registers show that October and November are the months of lowest levels in the Victoria Nyanza Lake. October 1st is therefore taken as a convenient date for comparison of the Lake levels from year to year. Between 1st August, 1897, and 1st September, 1898, there is a break in the record due to the rebellion of that period. The gauge-readings before and after this break were not referred to the same datum points, and therefore we cannot compare the present Lake levels with those of dates antecedent to the rebellion. The levels of the years for which the record is continuous are given for comparison below :—

YEAR.	Port Alice, (Entebbe.)	Port Victoria and Ugowe, or Kisumu.	Lubwas, (Usoga.)
	Ft. In.	Ft. In.	Ft. In.
1st October, 1898... ...	3 2	3 2½	3 1½
1st October, 1899... ...	2 6½	2 2	1 5
1st October, 1900... ...	1 7	1 1	1 0
1st October, 1901... ...	Not received.	1 8	1 6 *
			* 30th September latest received.

On the 1st October last, then, the Lake level had gained six or seven inches on the year before, but was still some eighteen inches lower than it was in 1898.

The telegram that was received in June, 1901, to the effect that the Lake level had risen 3 ft. 3 ins. in the space of 6 months, agrees with the Entebbe gauge-readings, which show a rise of 3 ft. 2½ ins. from January to May, no later readings than those of May having yet been received. But for the same period the other two gauges show a rise of a trifle under two feet only.

It might have been concluded, early in 1901, from the fact that the Lake was at a lower level on 1st October, 1900, than it had been a year before, that the summer levels of the river in Egypt would be lower in 1901 than they had been in 1900. And perhaps it was the leaves of the level register that breathed the spirit of prophecy into the seer who foretold that the summer of 1901 would be worse than its immediate predecessor, which had been the lowest on record. Fortunately he was wrong, and the register proved to convey the "little knowledge" which misleads. There are other influences in the wide extent of Central Africa which affect the summer discharges, and of these we cannot boast the possession of even a "little knowledge." It appears that the Lake levels are low after a low flood, and fall lower after a succession of low floods. But all that this tells us is that, when the autumn rains in Central Africa are deficient, there is less water to raise the Lake level, and to swell the Nile discharges both in flood and the succeeding summer. And this much could be assumed without a register.

CHAPTER II.

FLOOD SEASON.

In the last Chapter it was stated that the upstream level of the Barrage began to rise from its minimum of R.L. 13·58 on 27th June and reached R.L. 15·50 on 22nd July. This latter is the level of the crest of the Barrage gates with their top pieces of one and a half metres height which were added to the original gates as part of the Weirs project. Before this project was carried out, the level of R.L. 15·50 was not attained until about the middle of August or later. It was reached, for example, in 1898 on 11th August, which was unusually early; and in 1899 on 31st August. But now, until this level is reached, none of the river discharge is allowed to pass the Barrage, the whole of it being forced to flow into the canals taking off the river from above the Barrage. The upstream level is then maintained at R.L. 15·50 by a gradual opening of the Barrages as the river discharge increases in volume, until both are fully open. The further rise above R.L. 15·50 follows the natural rise of the river. On the night of 21st July, when the upstream level first reached R.L. 15·50, the Barrage and Weirs were holding up their maximum. The levels and heads on the combination of Barrage and Weir on the two branches at that moment are given by the following figures :—

BRANCH.	Upstream Barrage.	Between Barrrage and Weir.	Downstream of Weir.	Head on Barrage.	Head on Weir.	Total Head.
	R.L.	R.L.	R.L.	Met.	Met.	Met.
Rosetta ...	15·50	12·61	9·72	2·89	2·89	5·78
Damietta ...	15·50	12·48	10·05	3·02	2·43	5·45

The above maximum heads on the Barrages lasted for only a few days. During the greater part of the summer months of short supply, Damietta Barrage had been called upon to hold up under $1\frac{1}{2}$ metres head, and the Rosetta Barrage under 2 metres. But the Weirs had to bear more: for over a month, the head on the Rosetta Branch Weir was 2·99 metres, and on the Damietta Branch Weir 2·51.

The lowest levels below the Weirs recorded during the summer were R.L. 9·54 on the Rosetta Branch and R.L. 9·87 on the Damietta Branch.

The gradual opening of the Barrage, after R.L. 15·50 was reached, lasted from 22nd July to 19th August, when, the Barrage being fully open, the further rise above R.L. 15·50 began, and continued till R.L. 16·25 was reached on 28th August. This level is from five to ten centimetres short of what is required to give all the Delta canals full discharges. The level varied between R.L. 16·16 and the maximum R.L. 16·50 from 28th August till the 3rd October, so that the September levels were almost as good as could be desired. As, however, the river fell to R.L. 15·77 by the 11th October, while water was still required for the irrigation of winter crops in the high southern parts of the Delta, the Barrage was regulated on to produce and maintain till 27th October an upstream level of R.L 16·00, a head of 66 centimetres being the maximum resulting from the regulation.

The first water to pass the Barrage was given to the Damietta Branch to raise the downstream level below the Weir to R.L. 11·00 in order to supply water to the pumps along this branch. More than this was not at first given in order that the Zifta Barrage work might not be stopped. The increase given reached Benha in about twenty-four hours from its time of starting from the Barrage, and in another three days was at Damietta. The flow produced was sufficient to at once remove all deficiency of supply to the pumps along the whole length of the Damietta Branch from the Barrage to the sea.

The Damietta Branch was then kept at the level of R.L. 11·00, while the Rosetta Barrage was gradually being opened, until 5th August, when, the Zifta Barrage work being finished for the season and navigation clamouring for more water on the Damietta Branch, the raising of the Rosetta Branch was arrested when it had reached R.L. 13·50, and the Damietta Branch was then brought up to the same level. The two branches were afterwards raised at an equal rate until the Barrage was fully open on 19th August.

The flood was very similar to that of the preceding year and may be classified with it as a poor flood. Still, Lower Egypt had little to complain of, but much to be thankful for, if a comparison is made of its water supply in previous years of similar floods with that of 1901. The ideal, however, has not yet been attained. A more plentiful supply between 20th July and 20th August is still to be desired to enable the maize crop to be got in rapidly, and at the same time to sow Sabaini rice. If only a supply can be given in early August sufficiently abundant to meet the requirements of both the maize and the Sabaini rice crops, the chief of the objections to substituting Sabaini for Sultani will be removed. It is stated that, under hitherto prevailing conditions of supply, the Sabaini variety cannot be got in soon enough to be mature before cold weather sets in and damages it. And if this difficulty is got over, there will still remain the argument in favour of Sultani rice, that the hot and clear summer water, with which it is irrigated, takes up and carries away the salt from the land in a more efficient manner than does the muddy water of August and September. As the object of rice cultivation is the reclamation of salt lands by washing rather than the profit to be made out of the crop, this argument in favour of the Sultani variety has weight. But it is a most extravagant crop in its water requirements, and reclamation of lands by washing during a summer of short supply seems to be an utterly unjustifiable luxury, when the indulgence in it creates danger to the cotton crop that, by reason of its value, is a matter of concern of the first importance to the country. Moreover, in May, June and July, the liberal supplies, which are necessary to make the washings effectual, cannot be given in a year of deficient summer discharges. So that, if, in such years, the unrestricted growing of Sultani rice is an impossibility, it is desirable that the present drawbacks to the cultivation of Sabaini rice should be removed. As was pointed out in last year's Report, the operation of the Zifta Barrage, now under construction, will avail much. It is also under consideration whether it would not be quite safe, instead of maintaining a level of R.L. 15·50 above the Delta Barrage till all the gates are raised, to continue to regulate in such a way that the upstream level may rise to R.L. 16·30 sooner than it would do otherwise, the head on the Barrage constantly diminishing by the gradual opening of the gates and the consequent raising of the downstream level. It has been suggested that the regulation should be so conducted that the downstream level should rise at four times the rate at which the upstream level is allowed to rise.

The Nile from Khartoum to Aswan was at its maximum in 1900 from 17th to 19th August: in 1901 also it reached its first culmination from 15th to 20th August, but had a second slightly higher one from 31st August to 6th September.

In 1900, at Cairo and the Barrage, the natural flood maximum was reached on 3rd September, followed by an artificial maximum, due to the basin discharge, on 21st October. In 1901 the natural maximum was reached on the 25th September, but was followed by no artificial maximum. The maxima for the two years are given below:—

	1900				1901			
		Met.				Met.		
Khartoum...	17th August	6·27 (corrected)			20th August ... 1st and 2nd Sept.	6·10 6·10		
Berber ...	17th August	7·67			15th August ... 31st August ...	7·76 7·87		
Halfa ...	18th August	8·06			19th August ... 4th September ...	8·04 8·08		
		P.	K.	R.L.		P.	K.	R.L.
Aswan ...	19th August	16	5	=92·91	20th and 21st Aug. 6th and 7th Sept.	16 16	0 1	=92·80 =92·82
Rodah ...	3rd September 21st October	20 21	14 0		25th September...	21	8	
Barrage ...	2nd and 3rd Sept. 21st October... ...			16·40 16·45	25th September...	...		16·50

Some years ago, great importance was attached to the artificial rise of the river produced in the two branches of the Nile below Cairo by the discharge of the Koshesha basin. The most remarkable artificial wave produced was that of 1884, when the Irrigation Department was in a transition stage: the old system of arranging for the so-called regulation of the basin discharge (Sarf) had been abolished, and no working system had been substituted for it. In that year the Chief Engineer of Assiut effected his discharge by recklessly cutting all the basin cross-embankments in many places with, it was strongly suspected, the object of producing disaster in the neighbouring province of another Chief Engineer, and, probably, with the object also of discrediting the new regime before it had time to establish itself in the confidence of the country. The Chief Engineer of Minia, who had to dispose of the sudden influx of water from the Assiut basins, was forced to cut his banks freely and pass the water on. The same occurred in Beni Suef, until the final operation of cutting Koshesha bank had to be suddenly carried out, causing the river at Cairo to rise 1·42 metres in thirtv hours. The height reached by this artificial flood was of great benefit to Lower Egypt.

In 1891 also a wave was successfully produced by the first opening of the new Koshesha escape. The river rose at the Roda gauge from 20 pics 8 kirats to 22 pics 20 kirats, the ideal level aimed at being 23 pics. This result was greatly due to a natural rise of the river in the South, the effect of which reached Cairo at the same time as the combined effect of the basin discharges.

It is, however, as a rule, impossible to obtain a wave of sufficient magnitude to be worth much to Lower Egypt. The method adopted in 1884 was too happy-go-lucky to be repeated; and, moreover, the basins emptied themselves much too quickly in that year to suit the cultivators. Neither can the favourable conditions of 1891 be expected to repeat themselves except on rare occasions. In any case a wave worth having cannot be produced without sacrificing to some extent the interests of Upper to Lower Egypt. In past years when Upper Egypt was less known, and the far country beyond the railway terminus at Assiut was looked upon as a land of exile from the more favoured North, the interests of the near Delta loomed so large in the Ministry of Public Works that those of Upper Egypt were lost to sight. The benefit to Lower Egypt resulting from the artificial flood was magnified into something great enough to justify the disregard of the drawbacks to Upper Egypt attending the measures required to produce it.

But it has now, for the last three years, been accepted that it is better, in poor flood years, to allow Upper Egypt to retain its basin water for the irrigation of "Nabari," and to empty its basins as may best suit its needs, than to time its discharge so as to contribute to the production of a wave at the time of the discharge of Koshesha basin. And it has also been considered better to hold and discharge the water of Koshesha basin to the extent that is best suited to the irrigation of the West Giza basins and hoshas, than to devote it to the production of a wave, which, after all, would do little good. The deficiency of the flood levels can to a great extent, and with more certainty, be made good by regulation on the Barrage, and all that suffers by the failure to produce the artificial rise is the cultivation of the margins of an inconsiderable area of island land on the two branches of the river below the Barrage.

GIZA PROVINCE.

Considering the poor levels attained by the river, Giza Province did very well, and East Giza particularly so. There was an area of 1,200 feddans unflooded at the south end of East Giza, but most of this had grown a good Nabari crop, so that it would be reckoned only "half sharaki."

The successful irrigation of Giza in a year of such bad levels is to be attributed to the considerable improvements in its canal system carried out during the last few years with money granted, for the most part, by the Commissioners of the Caisse de la Dette from the General Reserve.

Owing to the low maximum of the flood, the usual dams at the head and at Kilometre 12 of the Rayyah Behera were not made, but the "Sarf" operations at Nikla were successfully carried out in the same manner as the year before. On account of the low levels also, the high Sahels (berms) outside the Nile bank in Giza and Behera had to be enclosed by temporary banks, and inundated from the canals within the Nile bank. In Giza £E.267 was thus spent in providing for the irrigation of 2,022 feddans : in Behera £E.1,093 was spent on the irrigation of about 4,000 feddans. Some of these lands should be permanently enclosed.

FLOOD WATCHMEN.

The year 1901 is the first year on the record in which not a single unpaid flood watchman was called out on the Nile banks in the Deltaic Provinces, north of the Barrage.

In Giza Province, which is a basin Province, it was necessary to turn out men on to the basin banks as usual, as, no matter what the Nile levels may be, the basin levels must always be made to reach the same maximum in order to complete the inundation of all the lands. Converted to the usual 100-day period for comparison, the number turned out was 161. The conditions of the flood were very similar to those of 1900, but better as regards height and duration than 1899. Therefore, if the efforts made to reduce the Corvée numbers had not had a yearly increasing effect, the numbers for 1901 would have been the same as those for 1900 and considerably more than those for 1899. But they are less than either, as the following figures show :—

Year.	Number of flood watchmen, Giza Province.
1899...	337 for 100 days
1900...	735 " " "
1901...	161 " " "

As the years 1893, 1897 and 1900 were years of floods similar to 1901, and 1899 was a year of lower flood, the numbers of Nile Corvée for those years are given below by Circles for comparison, to show what a steady progress is being made in the measures taken to reduce the number of men called out.

YEAR.	Numbers of Watchmen for 100 days			
	1st Circle.	2nd Circle.	3rd Circle.	Total.
1893...	3,063	3,944	3,335	10,342
1897...	183	724	1,525	2,432
1899...	None	65	661	726
1900...	249	1,531	1,730	3,510
1901...	None	None	161	161

The question of abolishing the flood Corvée has from time to time been raised and considered and dropped. In 1901 the question was again raised, and, in consequence, a systematic study of the Nile and basin banks was ordered. As a first step, kilometre posts, numbered from the Barrage as the common starting point, have been fixed on all Nile banks. Registers, containing detailed information about all dangerous points, have been drawn up, and much useful knowledge obtained and recorded for future use. Even if nothing further comes of the study, the knowledge obtained will be worth much, and will enable the Inspector without misgivings to resist the pressure of the local Engineers when they put forward their demands for men and materials at times and in places of no real necessity. But I hope that the study may pave the way for the total abolition of the Nile Corvée, not so much because it is objectionable in itself, but because it opens the door to abuses; and is moreover, in my opinion, a most inefficient instrument. When the work is paid for, we may expect to see as great an improvement in the manner of doing it as resulted from the abolition of the earthwork Corvée in the manner of maintaining banks and canals.

CHAPTER III.

PUMPING STATIONS.

Mex Station.

The Mex pumping station was complete before the beginning of the 1900-1901 season, and consequently the seven pumps, capable of lifting three million cubic metres in twenty-four hours, were ready for use if wanted. And the whole power of the station was actually made use of for a period of thirty-seven days to keep the Mareotis lake level down. In spite of this pumping, however, the water rose to a maximum of – 2·18 (metres below sea) on 19th January, 1901. The greatest quantity lifted in any one period of twenty-four hours was 3,425,862 cubic metres, the quantity recorded on 25th February. The total quantity lifted during the season, from 29th October, 1900, to 17th April, 1901, was 316,693,553 cubic metres, the heaviest season's work this station has ever done. This quantity was lifted at a cost of £E.14,182, which gives a rate per million cubic metres of £E.44.818.

The heavy rainfall of the winter season is given as one of the causes accounting for the high figure representing the volume pumped, but the figures given in the comparative Tables which follow seem to show that this cannot be the principal cause. The increase is, probably, due to the development of the drainage system, whereby lands, which were formerly swamps and acted as evaporating areas, have ceased to act as such; and the whole rainfall in the catchment area of the lake, together with the surplus water of the irrigation canals, finds its way quickly to the Mareotis depression, whence it has to be pumped into the sea at a rate sufficient to prevent the lake level rising to such an extent as to cause the inundation of the cultivated lands along its borders.

The high rate of the cost of pumping, as compared with earlier years, is due to the high price of coal, but there is a slight decrease on the rate of the year before, though the average price paid for coal was slightly higher. In 1901 the mean price was £E.1.746, whereas in 1900 it was £E.1.678 and in 1899 £E.1.237. The mean height of lift in 1901 was 3·02 metres and the quantity of coal consumed was 5,993 tons.

The rules governing the working of the pumps with reference to the levels of the lake were given in last years's Report.

TABLES OF COMPARISON.

SEASON	Quantity of water pumped, cubic metres.	Cost	Rate per million cubic metres
		£E.	£E.
1895–1896	175,078,166	7,588	43·004
1896–1897	216,994,810	8,068	37·000
1897–1898	227,429,530	8,675	38·000
1898–1899	284,896,064	8,378	30·000
1899–1900	202,987,741	9,391	46·261
1900–1901	316,435,869	14,182	44·818

SEASON.	Rainfall.	Maximum level of lake.	Date of maximum.	Minimum level in succeeding summer.	Date of minimum.
1895–1896	10·45	−2·15	17th March.	−3·15	22nd August.
1896–1897	8·53	−2·03	7th Jan.	−2·92	11th Sept.
1897–1898	13·94	−2·17	23rd Jan. & 13th March.	−3·20	27th August.
1898–1899	11·88	−1·95	18th Feb.	−3·26	16th Sept.
1899–1900	8·28	−2·29	27th Jan.	−3·29	11th August.
1900–1901	12·93	−2·18	19th Jan.	−3·23	17th August.

ATFEH STATION.

The Atfeh pumps were worked for thirty-six days at the end of the season of short supply to add to the Mahmudia Canal discharge. A total of 40,670,932 cubic metres of water were lifted at a cost of £E.2,155, giving a rate of £E.52.700 per million cubic metres. The mean lift was 1·83 metres, and the coal consumed was 496 tons. The coal cost £E.1.710 a ton.

The cost of the coal at this station was under three-sevenths of the whole cost, whereas at Mex the proportion was five-sevenths. This difference is accounted for by the fact that the Atfeh pumping station worked for only thirty-six days out of the whole year, so that the staff and maintenance charges were proportionately high. It is also due to the difference in lift and the less expenditure of coal with the smaller lift. At Mex 19 tons of coal were consumed in lifting one million cubic metres 3·02 metres : at Atfeh 12 tons of coal were consumed in lifting the same unit 1·83 metres. These figures are collected for convenience of reference in the following Table:—

SEASON 1900-1901.	Mex Station.	Atfeh Station.
Water lifted, cubic metres	316,435,869	40,670,932
Mean height of lift...	3·02 met.	1·83 met.
Coal consumed	5,993 tons.	496 tons.
Price of coal per ton	£E. 1.746	£E. 1.710
Total cost of pumping	„ 14,182	„ 2,155
Cost per million cubic metres ...	„ 44.818	„ 52.700
Tons of coal consumed per million	19	12

The above figures for Atfeh do not include a sum of £E.970 which was expended in the purchase of two new boilers ; nor do they include a further sum of £E.1843 representing the value of 1,078 tons of coal which were in stock at the end of the year. The expenditure on the station was thus made up:—

	£E.	
Maintenance and salaries...	400	
Repairs	339	
Cost of pumping...	1,416	
Total expenditure on season's pumping ...		2,155
Value of 1,078 tons of coal at the rate of £E.1.710 ...		1,843
Purchase of two new boilers		970
Total expenditure on station		4,968

The Atfeh station was served by fourteen boilers, seven of which were badly mounted at a low level. These seven, when dismounted for examination, were found to be so badly corroded as to be unfit for further use and they have all been condemned. They are at least fifteen years old. The remaining seven boilers, which are in good condition, are not sufficient to work the station, so it has become necessary to purchase more. Two were obtained at the close of the year for £E.970, and provision has been made by the transfer of Caisse Credit economies of 1901, for the purchase of three more, so that the station will soon contain twelve boilers in serviceable condition.

This pumping station requires a considerable expenditure on it to put it in an efficient condition. Among other things it requires a new roof. The water levels nowadays are higher than those to which the original project was adapted, and it has been found necessary to raise the scoop wheels by which the water is lifted. Further modifications to suit the altered conditions will probably have to be made to obtain efficiency.

Remarks on the Kassassin pumping station will be found in Chapter VIII, which deals with the Wadi Tumilat.

CHAPTER IV.

THE DELTA BARRAGE AND ITS WEIRS, AND THE ZIFTA BARRAGE.

The expenditure against the Budget allotments of the Barrage (which it is proposed in future to call "The Delta Barrage" to distinguish it from its new namesakes) amounted to £E.16,515 inclusive of establishment charges other than the salaries of officers on the permanent list charged to I.1.3. This total is thus made up:—

Establishment.		£E.
Staff and office charges		3,490
Works.	£E.	
River training	2,080	
Gardens: maintenance	900	
Garden alterations	52	
Nili canal head	983	
Asphalt paving	1,319	
Engine and boiler	240	
Model room	2,020	
Maintenance and repairs	5,430	
		13,024
		£.E.16,514

The establishment charges include a sum of £E.247 for superintendence charged against works (IX. 5. 1.).

The amount spent on River Training is rather less than usual. The work done is a continuation of what has been going on for many years, and, though slow in its action, is sure.

The garden maintenance cost £E.1,664, of which £E.900 was allotted from the Budget, and the remaining £E.764 was obtained from the garden fund, resulting from the sale of fruit, rents, etc. A further sum of £E.52 was given to complete some alterations in the garden, which it was undesirable to postpone.

A new head was built to the West Nili canal for £E.983. At first it was only intended to build a work that would carry the road along the Barrage front and make the revetment continuous. But, as a project for enlarging this Nili canal (now called the Nigâil) had been approved in principle, it was thought better to adapt the work to serve as the future canal head and to remove the old head. Strictly speaking, this work was not chargeable in full against the Barrage Budget.

It was pointed out last year that wood bricks, as a paving for the Barrage roadway, had proved a failure, and compressed asphalt bricks were to be substituted. During 1901 half of the Damietta Barrage was paved with asphalt and the trolley line doubled at a cost of £E.1,319. It should, therefore, not cost more than £E.4,500 more to complete the paving of both Barrages.

The £E.240 expended on the workshops, engine and boiler completes the expenditure on this account.

The Model Room for the reception of irrigation models is well advanced. A sum of £E.2,020 was spent on it in 1901 and £E.145 in 1900. It should be completed early in 1902.

The maintenance and repairs costing £E.5,430, were of the usual description, consisting chiefly of workshop charges, masonry repairs, painting iron work, and dredging locks and lock channels.

The Barrage Budget allotment for 1902 has been decreased by £E.1,225. There is no doubt it will stand further reduction when the works now in hand are finished, and probably the following figures will be found sufficient.

	£E.
River Training	2,000
Barrage maintenance and repairs	8,000

The Budget of the Barrage Directorate, which now includes the Giza Province will not, however, bear reduction, as the £E. 2,000, by which it may be found possible to reduce the Barrage expenditure, may well be given to Giza, for which the 1902 Budget allotments are insufficient.

THE WEIRS BELOW THE DELTA BARRAGE.

There was little left to be done to the Weirs to complete them entirely during the fourth season's work upon them. The core walls were built to full height and the crest ashlar laid, the rubble pitching up and downstream of the west bank of the Damietta Branch Weirs was completed; and a masonry bridge over the West Nili canal constructed to carry the permanent trolley line to the West Weir. The earthwork of the lock platforms and of the banks connecting with the weirs was also completed.

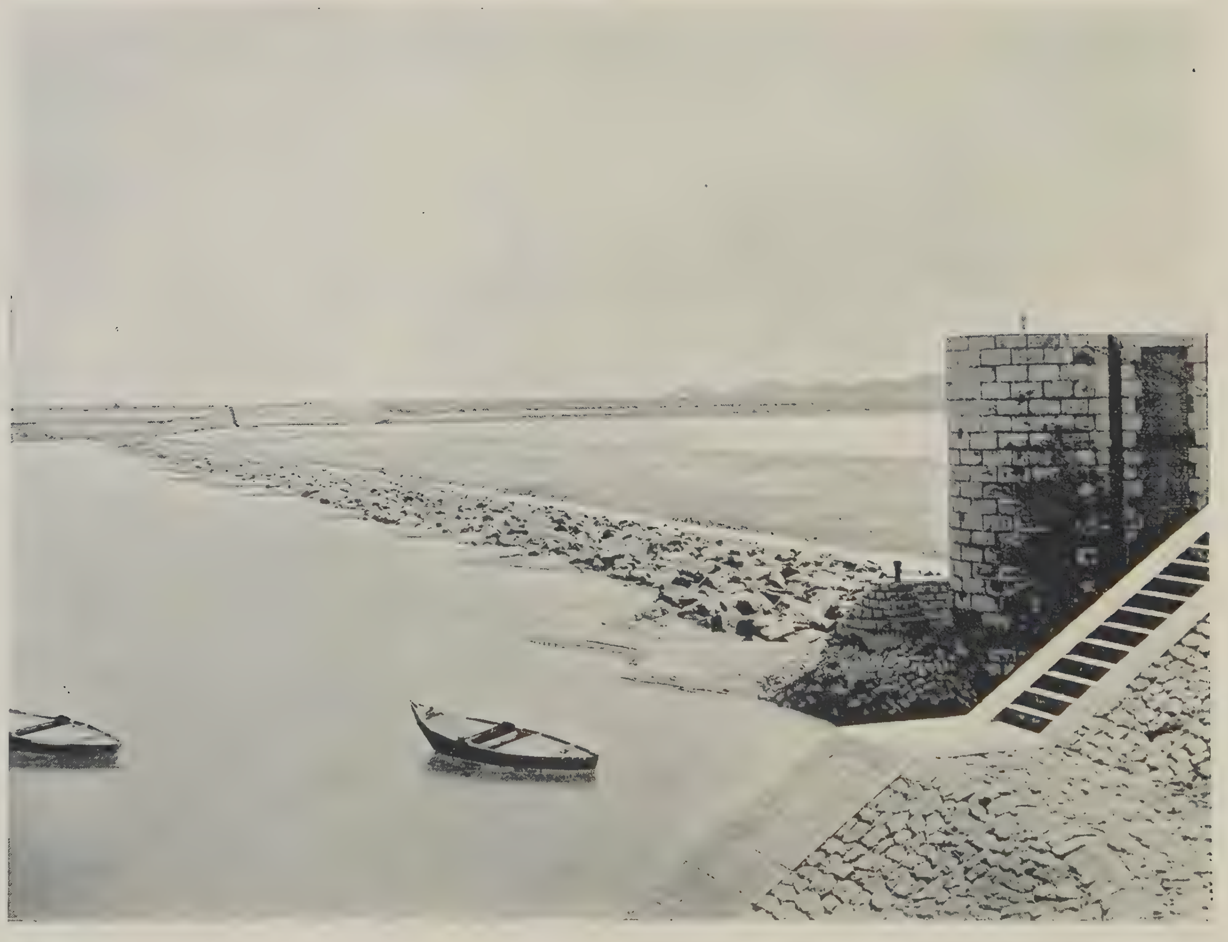
The last ashlar crest stone, completing the Weir core walls, was laid in the West Weir on 16th May, 1901. The date of this final completion had been retarded by the necessities of water distribution on the two branches of the river. Could these have been disregarded, the date of final completion would have been at least two months earlier.

The quantities of work done are given in the accompanying Table, showing the amount of work executed in each of the four seasons of construction. The expenditure during the year was £E.8,322. There remains to be expended in 1902 a further sum of £E.2,235 on lock-keepers' huts, clearance of stacking grounds, and general finishing-up work.

Including this projected expenditure, the total cost of the Weirs will amount to £E.434,000. The sum granted by the Caisse was £E.530,000, so that there is an unexpended balance of £E.96,000 which has been relinquished, to be made available for other objects of expenditure.

A large item in the expenditure was the cost of the 177,751 barrels of cement used in the work, amounting to about £E.100,000. It was unfortunate that at the time this cement was purchased the price reached its maximum. The rate per barrel of 360 lbs. was at first P.T. 50, rising afterwards to P.T. 60, which latter was the price paid for more than half the quantity. Good cement can now be obtained, delivered at the Barrage, at P.T. 46 the barrel, and, if this had been the case when the Weir cement was purchased, the works would have cost about £E.18,000 less than they did.

Plate I.



SUR. DEPT. P.W.M.

Delta Barrage Weir.

Besides the quantities of different descriptions of work shown in the accompanying Table of progress, the expenditure covers the cost of two pairs of lock gates of 12 metres width of chamber, 122 wrought-iron additions of 1½ metres height (183 tons) to the Barrage gates, and two winches for raising them, besides three bridges over canals for the trolley lines connecting the Weirs. The remodelling of the Nile banks between the Barrage and Weirs is also included.

The Weirs have now been used throughout a whole season and have proved thoroughly efficient and sound. The afflux (heading up of the water) at the Weirs is, even at mean flood, scarcely perceptible: it would be less so at high flood, but we have not had a high flood since the Weirs were built to demonstrate this.

It may be as well to record the exact levels of the crests of the two Weirs as they have been actually built. The crest of the Rosetta Branch Weir is throughout at R.L. 12·56. The crest of the Damietta Branch Weir is at R.L. 12·45 opposite the three centre compartments formed by the cross-walls, at R.L. 12·46 opposite the west compartment and at R.L. 12·47 opposite the east compartment.

The accompanying photograph of the Rosetta Branch Weir was taken on the 6th April, 1902, from the west end looking across the downstream end of the lock. On this date the Barrage gates were all closed and caulked, and the trickle of water passing over the Weir crest was due to springs in the river bed between the Weir and Barrage. The Weir was then holding up 2·98 metres and the Barrage 1·61, in all 4·59 metres, the actual levels being as below:—

	R.L.
Upstream Barrage	14·17
Upstream Weir	12·56
Downstream Weir	9·58

TABLE OF PROGRESS OF CONSTRUCTION OF WEIRS.

DESCRIPTION OF WORK.	Damietta Branch Weir and Lock.					Rosetta Branch Weir and Lock.			Both Weirs.
	1898	1899	1900	1901	Total.	1900	1901	Total.	Totals.
	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.	C.M.
Dredging	38,010	173,808	2,000	—	213,818	184,984	—	184,984	398,802
Earthwork	51,139	20,031	55,000	16,058	142,228	108,816	15,662	124,478	266,706
Grouted masonry	2,939	17,491	—	—	20,430	23,140	—	23,140	43,570
Skipped concrete...	400	1,260	—	—	1,660	—	—	—	1,660
Rubble masonry in homra and lime ...	641	4,144	774	—	5,559	3,531	—	3,531	9,090
,, in sand and cement ...	—	2,476	—	300	2,776	3,842	475	4,317	7,093
Brick masonry	—	1,300	3,728	—	5,028	5,011	—	5,011	10,039
Ashlar masonry	54	351	634	232	1,271	990	401	1,391	2,662
Dry rubble masonry	6,892	56,773	15,097	2,282	81,044	87,462	2,410	89,872	170,916
Heavy talus blocks	800	12,130	—	—	12,930	14,275	—	14,275	27,205
Clay on sides of walls...	4,000	15,785	1,566	—	21,351	33,730	—	33,730	55,081

The action of the Weirs in 1901, after the last crest stone had been laid, enabled us to utilise the whole summer supply of the Nile without subjecting the Barrage to a greater head than 1·37 metres. It also enabled us to raise the upstream level of the Barrage to R.L. 15·50 by the 23rd July, before any water was allowed to pass the Barrage; and, moreover, to do this, without subjecting the Barrage to a greater head than 3 metres. The maximum of 3 metres was further of short duration. Another most important result is the economy in dredging the canals Ismailia, Menufia and Behera which has followed the construction of the Weirs. Formerly, when the head on the Barrage was limited to four metres, it was not safe to leave undredged anything in the canal beds above the old theoretical bed levels. But now, with the power the Weirs have given us of raising the upstream level by another one and a half metres or more, it is quite safe to leave undredged what would not have been safe before, as compensation for the effect of obstructions can easily be made by regulation on the heads of the main canals. The summer distribution can thus be easily adjusted. What, however, we have to be careful about is that the canal waterways shall not diminish to such an extent as to seriously affect the discharge in early flood when the upstream level of the Barrage is kept at R.L. 15·50 and canal heads are fully open.

ZIFTA BARRAGE.

Before the Weirs were completely finished, another large work was taken in hand. A Barrage on the Damietta Branch at some point between Zifta and Samanud was proposed some years ago, and a design for it was made by Mr. Willcocks as one of the Reservoir group of works, before the Weirs had even got beyond the stage of vague suggestion. The construction of the Weirs has to some extent diminished the necessity for a Barrage on the Damietta Branch, but the advantages to be derived from such a work are still sufficiently great to justify its construction. In spite of the power the Weirs give us of raising the water surface above the Delta Barrage to the level that gives nearly maximum discharges at the canal heads, taking off above it, as early as the last week in July, the demand for water is everywhere so great that rotations cannot be taken off until after 15th August. On page 174 of the second edition of "Egyptian Irrigation" Mr. Willcocks, after pointing out that the August waters of the Nile are particularly rich in fertilising mud, expresses his opinion that "any canal which needs rotations in August to enable it to carry water to its tail is quite inefficient." Though the expression may be a little too strong, he is probably right in suggesting as ideal a system of canals so disposed that, from the beginning of August, a plentiful supply of the rising flood water can be given at all points throughout it without rotation, until everybody is satisfied. With the Zifta Barrage in operation we shall obtain a new point of supply from the river to the canals at about the centre of their lengths, so that, at the end of July, we shall have the northern parts of the Delta drawing from canals flowing with such discharges as will satisfy all demands, and there will be no necessity to keep on rotations on the canals of the southern half of the Delta in order to force water forward to the North. This we may confidently predict as one advantage to be gained.

It is more difficult to be precise about the use that will be made of this Barrage in summer. With an abundant supply of summer water, it will doubtless be found most convenient to use the Damietta Branch as being one of the main irrigation channels taking off from above the Delta Barrage, and to apportion to it its proper share of the water to be distributed to the north parts of the Delta by the canals taking off from the river above the Zifta Barrage. With such scanty summer supplies as we have had in 1900 and 1901, and are expecting again in 1902, it would probably be found more economical of water to pass the available supply forward by the canals, and *not* to utilise the river channel for that purpose. But as the Aswan Reservoir will come into operation simultaneously with the Zifta Barrage, such severe conditions of summer supply need not be considered.

It will be one of the functions of this Barrage to intercept the discharge of the river due to springs along the river bed and to infiltration from the bordering lands between the Barrage and Zifta; and to make this supply also available for purposes of irrigation. Recent experience has, I consider, shown that the discharge due to such sources has been overestimated in previous reports. Moreover, the heading up that will take place at the Zifta Barrage before such water can be utilised will itself tend to check the springs and lessen the volume due to their working, so that we must be cautious in our estimates of what results may be expected on this account.

The Barrage is designed to hold up 4 metres of water. It will have fifty openings of 5 metres width with abutment piers between each group of ten. The design is the same in its main features as the Assiut Barrage, with cast-iron piles of special form up and downstream of the floor and round the lock. The piles along the upstream face are 16 feet long, while those along the downstream are 10 feet only, which is a departure from the Assiut design. The floor section of the Zifta Barrage is given on the accompanying Plate.

The lock at the west end has a chamber 12 metres wide and 65 metres long, the same dimensions as the Weir locks. It will be provided with a lift bridge for the road traffic between the two sides of the river, hitherto carried on by a ferry of the usual unregenerate village type.

The Barrage with its lock may be expected to cost £E.350,000; and the subsidiary works, required to put the work into gear with the existing system of canals, will probably cost another £E.150,000. The cost of the land to be expropriated for the main connecting canals forms a very large item in the estimate, as it is some of the best in Egypt.

A sum of £E.86,000 was asked of the Caisse to meet the first season's expenditure on preparatory work such as purchase of plant, collection of materials and building houses for the staff. The Inspector General of Irrigation was informed on 27th December, 1900, that this grant had been made.

Though the preparatory work just mentioned was all that was at first contemplated for the first season's work, it was decided to make an effort to get in the lock foundations and about 50 metres length of the regulator floor, so that this portion of the work might be used in the second season for the passage of the river discharge while the rest of the foundations were being got in. The difficulty of getting a sufficient number of the cast-iron piles supplied in time made success doubtful. Only a limited number of piles could be manufactured in the country in the short time available, so the remainder had to be got out from England. The excavation of the foundations proved to be an easier work than had been expected, as, at foundation level, a stratum of stiff clay spread over two-thirds of the lock area and also over most of the length of regulator taken in hand.

The piles were supplied in good time, and the first pile was driven on 5th May, 1901. Concreting in the lock floor was begun on 19th May. By the end of July the lock foundations and sills up to 5 metres height above foundation bed had been built; and also a length of 71 metres of the regulator floor 3 metres thick, with the pier bases on this length up to 1·60 metres above floor level.

The progress made with the work itself, and with the collection of materials was so much better than the original forecast that the £E.86,000 granted for the year's expenditure was found insufficient. Fortunately, the savings on the Weirs allotment was available, and the Caisse consented to a sum of £E.44,000 being transferred from the

Weir grant to Zifta Barrage, thus bringing the total available for expenditure in 1901 up to £E.130,000. The actual expenditure for the year was £E.121,100, distributed as follows:—

	£E.
Establishment	3,076
Houses	6,638
Land	1,729
Sundries	537
Plant ... ..., ...	497
Labour	20,739
Earthwork	7,518
Timber, coal and stores	6,829
Ironwork	12,515
Purchase of materials	55,344
Transport	5,637
Total	121,059

The remarkable part of this list of first season's expenditure is the small figure against plant. The purchase of plant was discouraged, because, in 1902, all the extensive plant of the Assiut Barrage, which is the property of Government, would be available. This was felt as a drawback at Zifta during the 1901 season, as Assiut was not ready to part with its plant, and Zifta might not buy. Fortunately, the Delta Barrage plant, which was used for the construction of the Weirs, was available, and some of it was suitable for Zifta. A contract was further made with the Delta Light Railway Company for the transport of materials by their rolling stock over lines which the Company itself laid down. The Light Railway has been of great use to us. The State Railway laid down a siding from Zifta to the works, by which cement, piles and other goods coming along the State Railway were delivered on the works. The Zifta Barrage was charged with the whole cost of this siding, the State Railway profiting from the goods carried and from the extra rate charged for the transport along the siding, without any extra expenditure being incurred by them to obtain it.

The quantities of permanent work done during the first season were:—

202 lineal metres of 16-feet piles driven,
116 „ „ of 10-feet „ „
13,000 cubic metres of rubble and ashlar masonry,
5,328 „ „ of concrete,
5,410 „ „ of dry rubble work,
and a corresponding amount of filter bed and clay puddle.

Before the end of the year 1901 the second season's work was begun. The bottom grooves of those piers, which had been begun in the first season, were fixed, and the piers built up to the top of the grooves, three metres above floor level. The bays between these piers were thus made ready to pass the river discharge so as to allow of the rest of the foundation area being enclosed by earth dams and pumped out for the piles to be driven and the floor built. Over these piers a bridge for the passage of workmen has been since made: along the downstream dam the Light Railway runs, a temporary bridge being provided to carry this railway and to pass the river discharge. The work is progressing well and will, it is confidently expected, be in working order by the summer of 1903.

Mr. F. A. Hurley, Director of Works, has been the Resident Engineer in charge, and has had to organise the whole work with very little assistance from Head-quarters. Everything has gone well, and the conduct of the work has been much to the credit of Mr. Hurley, whose length of service was at first considered to be insufficient to qualify him for such an important charge. His first season's work has been so satisfactory, that it is deemed sufficient justification for leaving him in charge and giving him an opportunity such as rarely falls to the lot of so young a man.

CHAPTER V.

NEW WORKS OF IRRIGATION AND DRAINAGE.

The following statement gives the figures of the expenditure of the year 1901 *without* regard to Budget Heads or sources from which funds were obtained. Appendix A gives the expenditure as it appears in the official records of accounts, separated according to the budget and other grants.

The establishment charges of the statement which follows exclude the pay of the permanent officials which is charged against Chapter I of the Budget, as the Circle accounts do not include *all* the payments under this head. The amounts are made up of the pay of Hors Cadre, special rotation staff, regulation gaffirs, special staff on new works, and staff other than daily labour: they include all office charges and hire of dahabias. The working staff of the pumping station and the staff on road construction are not included under establishment, but under works.

The Wadi Tumilat expenditure on works and staff has been excluded from the statement, as this is separately dealt with in Chapter VII.

Chapter of report.	Heads of expenditure.	1st Circle.	2nd Circle.	3rd Circle.	Delta Barrage.	Zifta Barrage.	Total.
		£E.	£E.	£E.	£E.	£E.	£E.
	Establishment.						
	Pay of staff, offices and instruments..	12,002	12,507	11,309	4,353	3.076	43,247
	Works.						
Chap. I.	River temporary dams	4,746	—	8,187	—	—	12,933
Chap. III.	Pumping stations, including staff ..	—	—	19,825	—	—	19,825
Chap. IV.	Weirs below the Delta Barrage ..	—	—	—	8,322	—	8,322
"	Zifta Barrage	—	—	—	—	117,983	117,983
Chap. V.	Irrigation Improvements: Small masonry works..	2,163	11,960	842	3,003	—	17,968
"	Irrigation Improvements: Large masonry works..	32,615	1,900	33,115	39,549	—	107,179
"	Irrigation Improvements: Earthwork in new or remodelled canals..	3,351	5,376	11,426	—	—	20,153
"	New drainage works..	44,668	57,463	32,037	—	—	134,168
Chap. VI.	Protective works..	6,785	13,379	10,108	2,080	—	32,352
"	Maintenance: Masonry and buildings.	3,271	3,817	2,036	*7,143	—	16,267
"	" Gardens	—	—	—	1,716	—	1,716
"	" Earthwork	53.154	53,355	36,163	—	—	142,672
"	" Dredging	23,247	4,539	10,535	—	—	38.321
Chap. VII.	New roads, including staff	7,114	10,647	373	—	—	18,134
"	Roads maintenance	1,432	1,229	500	—	—	3,161
"	Ferry fund bridges	300	4,897	—	—	—	5,197
"	Land charges	—	3,224	262	—	—	3,486
"	Sundries	313	1,028	773	—	—	2,114
	Totals, works	183,159	172,978	166,182	61,813	117,983	701,851
	Grand totals	195,161	185,485	177,491	66,166	121,059	745,198

The river temporary dams in the Rosetta and Damietta branches have been referred to in Chapter I, and the pumping stations in Chapter III.

This chapter deals with the expenditure on new works and works of remodelling under the heads of irrigation improvements and new drainage works, the work under the other heads belonging to other chapters. The new weirs below the Delta Barrage, and the Zifta Barrage are, however, grouped with the Delta Barrage in Chapter IV. All works of repair and ordinary maintenance are described in Chapter VI.

IRRIGATION IMPROVEMENTS AND NEW DRAINAGE WORKS

The following special grants to Lower Egypt were made by the Commissioners of the Caisse de la Dette for expenditure in 1902:—

	£E.
Irrigation Improvements	110,000
Drainage Works	165.000
Damietta Branch "Sadd"	5,000
Rosetta Branch "Sadd"	9,000
Atfeh pumping station	7,500
Bahr Saidi pumping	3,000
Special expenditure on account of low summer discharges ...	2,500
Zifta Barrage	86,000
Total	388,000

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* This includes repairs to plant and the upkeep of the whole of the Barrage, exclusive of gardens.

To these the unspent balances of the former year were added, and transfers made from time to time during the year. The accompanying statement records all these balances, allotments and modifications, as well as the years' expenditure against each head and the unspent balances remaining at the end of the year 1901.

There were, in addition, allotted from the Reserve of the Public Works Budget the following sums for expenditure on "Irrigation Improvements":—

	£E.
1st Circle	9,000
2nd Circle	9,000
3rd Circle	5,000
Barrage	9,500
Total	32,500

CAISSE CREDITS, 1901.

	Balance from 1900.	Original allotment, 1901.	Total.	Modified.	Expenditure.	Balance to carry forward.
	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.
Irrigation Improvements.						
1st Circle	2,055.387	35,000.000	37,055.387	37,055.387	27,009.238	10,046.149
2nd Circle	1,268.095	30,000.000	31,268.095	24,114.095	17,795.301	6,318.794
3rd Circle	23,459.790	20,000.000	43,459.790	44,142.790	42,323.171	1,819.619
Barrage	—	25,000.000	25,000.000	37,252.000	33,711.206	3,540.794
Zifta Barrage	—	86,000.000	86,000.000	130,000.000	121,059.338	8,940.662
Drainage.						
1st Circle	—	60,000.000	60,000.000	60,000.000	47,579.729	12,420.271
2nd Circle	—	70,000.000	70,000.000	64,902.000	58,816.316	6,085.684
3rd Circle	—	35,000.000	35,000.000	35,124.000	32,615.710	2,508.290
Sadd, Rosetta Branch . ..	—	9,000 000	9,000.000	8,193.000	8,187.448	5.552
Sadd, Damietta Branch. ..	—	5,000.000	5,000.000	5,000.000	4,745.891	254.109
New Weirs	56,557.209	50,000.000	106,557.209	10,557.209	8,321.810	2,235.399
Special Low Nile.						
1st Circle	0.800	800.000	800.800	718.800	578.368	140.432
2rd Circle..	3.600	3,900.000	3,903.600	1,203.600	544.470	659.130
3rd Circle...	10.233	8,300.000	8,310.233	7,092.233	5,146.779	1,945.254
Barrage	150.627	—	150.627	150.627	150.627	—
Special dredging, Mahmudia.	1,117.818	—	1,117.818	1,117.818	1,117.818	—

SMALL MASONRY WORKS.

"New and remodelled masonry works," costing less than £E.3,000 each, other than those executed and paid for as drainage works, or as part of the construction of new roads, are given in the following list:—

	£E.	£E.
1st Circle.		
Ghazali Canal Regulator	175	
Safaria Canal Tail Escape	50	
Khalig Imri Road Bridges	63	
Bilbeis Regulator on Shibin Canal, remodelling	900	
Railway diversion for Saidia Canal Head (1900)	153	
Ismailia Lock-keeper's House	300	
Road Bridges on Sayala and Siru drains..	224	
Gauges, grooves and closing-planks	298	
		2,163
2nd Circle.		
Pipes for Mitbera Canal	800	
Pipes for Naggar and Nanaiïa Canals	1,200	
Sluice openings in Qodaba Lock gates	712	
Emesha Canal Tail Escape	155	
Bimam " "	240	
Ghanam " "	230	
Um Abdalla " "	350	
Batanunia " "	235	
Salamunia Canal Regulator	410	
Banawan " "	230	
Bishma " "	230	
Kahwagia " "	320	
Shanshuria " "	350	
Ariamum Canal Tail Escape	312	
Shabas Syphon (balance of cost)	272	
Emesha Canal Head, remodelling	230	
Salamunia " "	222	
Kotni " "	200	
Ganabia Shabshir Head Sluice	841	
Mehallet Malek Regulator on Qodaba Canal	650	
Yusuf Effendi Canal Head Sluice	320	
Sanhur el Kebir Canal Tail Escape	380	
Bahr Qîs Head Sluice	280	
Loumania Canal Head Sluice	258	
Tabania " "	270	
Mitbul " "	180	
Mafruza " "	350	
Hamra Regulator on Rowena Canal	320	
Rowena Canal Tail Escape	150	
Safti " "	100	
Bahr Biela Head Sluice	395	
Bahr el Aama Head Sluice	259	
Nili culverts, Kodaba Canal	505	
Sundries	4	
		11,960
3rd Circle.		
Galaa Canal Head Sluice	150	
Bridge over Rosetta Canal flood Feeder	185	
Road Bridges	398	
Rosetta Canal Head Sluice at Atfeh (balance)	109	
		842
Barrage.		
West Nili Canal Head	983	
Model Room	2,020	
		3,003
Total...		£.E.17,968

Of the foregoing works there are few that require any special observations.

The Bilbeis Regulator on the Shibini Canal is an important regulator which was in a ruinous condition and required more than ordinary repairs to put it in order.

In the 2nd Circle list, the pipes for Mitbera Canal are destined to form a syphon which is to take the place of a clumsy level crossing, contrived by the yearly construction of dams which have to be yearly removed.

The pipes for the Naggar and Nanaïia Canals are for syphons which form part of a comprehensive project for the improvement of the irrigation conditions of the high lands along the West Nili Canal which has its head at the Barrage. The West Nili Canal Head at the Barrage was also built to a design suitable for the remodelled canal as projected.

The sluice openings in the Qodaba lock gates take the place of an escape which it had been proposed to build alongside the lock. When the question of so placing the escape as to scour out the lock channel was under consideration, Mr. Dupuis proposed to substitute for the escape as many sluice openings as could be fitted in the lock gates. His proposal was adopted and carried out at a cost of £E.712, which was a great reduction on the cost of the project for which the arrangement was substituted. The cutting down of the sill of this lock and the alteration to the lock gates caused some temporary inconvenience to navigation. The lowering of the sill by 1·25 metres, from R.L. 3·50 to R.L. 2·25, was done under the head of repairs at a cost of £E.813.

The Barrage new works are described in Chapter IV.

The other works are all either works of regulation designed to improve the means of water distribution and control, or road bridges for the convenience of traffic. The more important works executed during the year and not included in the foregoing list are described in Chapters IV and V.

LARGE MASONRY WORKS.

With the large masonry works has been included the group of Giza works, although they comprise a number of small masonry works and the earthwork of connecting channels. They, however, form together one project of Irrigation Improvements.

The following is the list of these more important works :—

	Expenditure, 1901.	
	£E.	£E.
1st Circle.		
New head to Ismailia Canal at Shubra	29,269	
Additions to Siriakos Regulator	3,346	
		32,615
2nd Circle.		
Lock addition and remodelling Dimera Regulator ...	1,900	
		1,900
3rd Circle.		
Khatatba flood feeder to Rayyah Behera	15,699	
Mahmudia Canal bridges in Alexandria	3,250	
Giza group of works	14,166	
		33,115
Barrage.		
Additions and remodelling Rayyah Behera Head	20,643	
Nikla Regulator at Kilometre 6 of Rayyah Behera ...	17,123	
Giza group of works	1,783	
		39,549
Total...		£E.107,179

NEW HEAD TO ISMAILIA CANAL AT SHUBRA.

The Shubra Head to the Ismailia Canal has for many years been defective as the head of a navigable canal, inasmuch as there are only one pair of gates to the lock. After the gates had been hung, the lock chamber and the downstream wing cracked so badly that the lower lock gates had to be removed and the wing wall dismantled. Consequently, whenever the Head was being regulated upon, navigation was interrupted. Some years ago an attempt was made to repair the work, but, as far as can be learnt, the repairs of the floor were neither completed, nor, as far as they were carried out, were they satisfactory. In 1897, also, the late Mr. Kinipple applied his stock-ramming system to the separated end of the lock, but no confidence was felt in the result. Not only is this Head Work unsound, but it is of insufficient waterway. Further, it is situated at such a distance from the river that a large annual expenditure in dredging is necessary to clear the channel between it and the river.

For the reasons stated it was felt that in spite of its costliness a new Head was a thing to be desired and to be built if funds could be provided. Fortunately the policy of the Caisse in granting sums for expenditure on Irrigation Improvements, instead of for drainage works only, has made the execution of this work a possibility. The subsoil which has to support the work, is a treacherous one to build on, and is more or less of a quicksand with springs rising all over it. It was, therefore, decided to sink wells to enclose the whole area of the foundations and to form deep curtain walls. A row of wells was also provided under the outer lock wall. During the 1901 season all these wells were built and sunk to the required depth at a considerable cost. By some misunderstanding or an unfortunate ambition of the Engineer in charge to execute more than the programme of work contemplated, the work was carried on long after the rise of the flood produced conditions unfavourable to further progress, with the result that the cost of the work has been unduly augmented and the filling of the wells with concrete was unsatisfactorily done, so that further expenditure, which should not have been necessary, will be incurred in putting things right.

One of the items which adds considerably to the cost of this work is the deep diversion which had to be made to admit the canal supply at low summer levels. The cost of land required was also excessively high on account of the work being in the neighbourhood of Cairo.

The expenditure in 1901 was £E.29,269. It is estimated the total cost of the finished work will amount to £E. 61,368.

In connection with this work, it has been decided to construct supplementary works to provide additional waterway to the Siriakos and Bilbeis Regulators on the same canal. A commencement was made in 1901 with the additions to the Siriakos Regulator, and a sum of £E.3,346 was expended on excavating and getting in part of the foundations. As this work also has to be built on soil similar to that at the Head, it was decided to enclose the foundation area by wells. The total estimate for the Siriakos additions is £E.9,500. The Bilbeis additions with probably cost much the same.

DIMERA REGULATOR AND LOCK.

In the northern half of Gharbia there are several lines of navigable canals in communication with the railway at Rahben, but the north part of the Bahr Shibin, which has two newly built locks upon it to provide for navigation, is cut off from the rest of the group by the regulator at Dimera which has no lock. This want is now to be supplied and a lock is to be built, while the old regulator is at the same time to be remodelled. A sum of £E.1,900 was expended during 1901 in the collection of materials. The work should be easily completed in 1902. The total estimate is £E.6,891.

RAYYAH BEHERA WORKS.

Three important works were put in hand on the Rayyah Behera in 1901, viz., the Head Works at the Delta Barrage, Nikla Regulator and Lock at Kilometre 6, and the Khatatba Flood Feeder.

Rayyah Behera Head.—The Head Regulator of the Rayyah Behera is the sole remaining unregenerate specimen of the group of works at the Barrage. Its floor was a few years ago added to and strengthened, but the superstructure is as it was before the Barrage was made to work. The old clumsy vertical closing timbers, shear-legs, pulleys and guy ropes encumber the roadway whenever regulation is going on, and the lock has ever been a lock without gates. The waterway provided would, without the lock, be insufficient now, and, even with the lock, it it is calculated that it will not suffice to pass the discharge of the canal when future developments of Behera Province are accomplished. Therefore it has been decided to add more waterway and a lock. The uncertainty as to the foundations of the old work, and the fact that the old lock was on the wrong side of the canal, decided the question as to whether a new lock should be built, or the old one be fitted with gates. The project provides for a new lock and two more sluice ways, for converting the old lock into two sluice ways by building a central pier on its floor, and for fitting all the seven openings with iron gates and a winch on the same pattern as the Barrage. For reasons connected with the discharge of the Giza basins, the lock has to be given a third pair of gates, and the piers have had to be designed so as to resist a head from the canal side also.

It was considered desirable to build the new additions as close to the old work as possible, so that the completed work might be one single work and not two separate ones. The decision to attempt this resulted in a period of considerable anxiety while the foundations were being got in. For the foundations of the old work were at different levels and, at points, higher than the foundation level of the new work. Moreover, the canal was flowing close alongside through the old work at a level four metres above the bottom of the excavation, while the backing of the abutment of the old work had to be entirely removed. The laying bare of the back of the abutment disclosed an extraordinary method of construction; the upper portions projected beyond the lower, to support the parapet walls, without any corbelling out; there were hollows where the abutment and wings joined, into which a boy crawled out of sight. The work seemed to have had no wings of any consequence to begin with, and then to have had wings added on two different occasions.

When the excavation had reached a certain level, the nearest arch of the old work developed cracks, and serious settlement was evident in the wings with high-level foundations. Pumping was, therefore, stopped, the water allowed to rise to the canal level and the rest of the foundation was got out by a dredger, the dredging not being allowed to approach the wings too closely. When the dredger had done its work, perforated pipes were arranged over the whole area, 1½ to 2 metres depth of rubble was deposited round them, and the floor was formed under water by the cement-grout method, as in the case of the foundations of the weir locks described in former Reports.

The passage in the surrounding banks, made for the entrance and exit of the dredger, was then closed, and the grouted floor was laid dry by pumping. All seemed sound, except that some of the cement on the surface had not set hard and wide cracks formed in it. The cement below was found so hot that it blistered the fingers. The peculiar behaviour of some of the cement was never satisfactorily explained : it may have been that it was too new and developed too great a heat in setting. The inferior upper coating of cement was removed until hard cement was reached. Building on the top of it was then begun. Before much of this building had been executed, the downstream portion of the floor cracked, on several lines, and springs made their appearance along the cracks, finding their way through the grouted layer of masonry. I have no doubt whatever that this was due entirely to the pump being set up too near the edge of the floor and to the action of springs along that edge. The subsoil was carried away by the springs to the pump from under the grouted floor, which settled down as soon as it was left unsupported.

We had then to decide what next to do. The first thing needful was to stop the pump doing further damage. The inlet to the pump-well was shifted, and the springs along the edge of the floor were rendered comparatively harmless by making them pass through pebbles and concrete metal weighted with a layer of sacks of earth. A narrow width of the downstream edge of the floor was got in to full height by skipping concrete between two walls of sacks formed on the grouted slab, and this skipped masonry was then connected up with the higher parts of the work. As soon as this bounding wall was complete, the water outside was allowed to rise to the top of it, and the rest of the floor got in by pumping from *inside* of the wall, so as not to draw on the springs coming up along the downstream edge of the floor. Other cross-walls were made and the floor got in by compartments, every spring being confined in a pipe and treated to a head of grout greater than the head on the spring. Piece by piece the whole floor was worked in and all the springs stopped.

While this was being done, the floor was carried towards the wings of the old work to join up with it, in narrow widths at a time, and was continued far enough to underpin the old walls. When the floor had been joined up with the whole length of the wings, an extra thickness was given to it along the foot of the wall to make the junction more secure. The junction between the old and new work was frequently treated to cement-grout, so as to get a water-tight junction, and to fill the irregular hollows and cracks in the old work.

The superstructure of piers and lock-walls was then carried up a few metres, and work was stopped for the season when the river rose. Bore-holes all over the piers and lock walls were jumped to the underside of the foundations, and cement-grout poured down them after the manner employed on the Barrage. After the flood, the floor also was systematically bored all over, pipes fitted into the bores, and into every hole cement grout was poured until a colum of grout higher than the water in the adjacent canal was obtained in the tube. Only a few of the bores took more cement grout than was sufficient to fill the bore and pipe, showing that the cavities under the floor could not have been extensive. By the end of the year the building had been resumed, and it is hoped that the whole work may be finished in 1902.

Mr. Grieve, who has been in immediate charge throughout, had great difficulties to contend with. His energy and devotion to his work overcame them and, I believe, the new construction is now sound throughout. The old work we hope also to consolidate and remodel during 1902. The total estimate of the additions and remodelling amounts to £E.38,735 of which £E.5,029 was expended in 1900 in the collection of materials, and £E.20,643 in 1901 in building the new part of the work.

NIKLA REGULATOR.

The Nikla Regulator is situated at the sixth kilometre of the Rayyah Behera Canal, just downstream of the Nikla railway bridge, through which the water of the Giza basins is discharged. Hitherto the Iswid basin has been emptied by making a cut in an earth bank formed annually at a little distance from the railway bridge on the basin side. On the cut being made, the discharging water entered the Rayyah Behera, and found its way partly down the canal and partly across it into a basin on the right of the canal through a cut in the canal bank. In the absence of means of regulating the levels in the canal at this point, this discharging operation was always one of considerable danger, and careful arrangements had to be made to control the levels further down the canal. A complicated programme for the manipulation of the scattered regulators and escapes had to be drawn up, and instructions given to the agents who had to carry it out. These agents, when at their different posts, were spread over a long line and cut off from any communication with the directing officer, so that no means existed of modifying their instructions to meet any unforeseen perturbation. Obviously the conditions were favourable to something going wrong sooner or later.

The new regulator gives the control required. By means of it the discharge to be allowed to flow forward in the canal can be regulated, and the level of the water be held up to that required for the proper irrigation of the basin across the canal. But it will do much more than this. It will make it unnecessary to close the breach in the bank on the basin side of the railway bridge and save this expense. It will enable us in a good flood to pour red water into the Iswid basin at its lower end, where for many years none has come. It will help to fill the same basin at an earlier date than usual. It will give us the power of turning red water over the sandy wastes along the left bank of the Rayyah Behera, and so more effectually stop sand drift and, in time, render the land fit for growing any crops. It will make it possible to give the basin on the right of the canal water early in the flood and a prolonged soaking. Hitherto these lands have had to wait till the final basin discharge for their inundation, which, being late, could not be prolonged. It will give us the power at the time of the discharge of the basin to create a back flow of high velocity through the head into the river, which will not only help to get rid of the discharge of the basins, but will create a scour that will carry away at least some, if not all, of the silt deposited during flood in the channel between the head and the river.

The work consists of a lock of 8 metres width and 35 metres length between gates, and a regulator of five vents of 8 metres width, fitted with triple iron gates sliding in threefold grooves and lifted by the ordinary Barrage pattern of winch.

To get in the work an expensive diversion of the canal had to be made sufficiently large to take the flood supply. The construction was not attended with any special difficulties, as the springs were easily kept under by two six-inch pumps, the foundations being over hard clay. The work has been well built by Messrs. Bianchi and Baldi under

Mr. Stent's superintendence. A sum of £E.17,123 was expended during 1901 : the total estimate is £E.26,452. The masonry was practically finished during the year, but the lock gates remained to be put together and hung in 1902.

KHATATBA FLOOD FEEDER.

The third work on the Rayyah Behera was the Khatatba Flood Feeder. This is a regulator of seven vents of 5 metres each without a lock. It is designed to act as the flood head to the Rayyah Behera when the river levels are suitable, and also sometimes to serve as an escape. When the river during flood reaches a certain height, the head at the Barrage is closed and this feeder opened. Hitherto an earthen dam was yearly made and cut to carry out this arrangement. When once the dam was cut, the discharge of the canal depended on the height of the flood in the river, subject to no control. In high floods, consequently, dangerously high levels were produced in the canal, necessitating the cutting of the canal banks lower down to let the excess back into the river. It has sometimes happened that the dam has been cut, and the cutting has been followed by a fall in the river, necessitating the rapid closing of the dam again, thus causing fluctuations in the canal supply. All these drawbacks will disappear now that a proper regulator has been built: we shall now be able to open and close the head as we like, and feed the canal either from the Barrage or from Khatatba, as may be most suitable, without any difficulty. The whole work was built entirely in 1901 at a cost of £E.15,699. It is a very well-built work, in spite of its being in an out-of-the-way place, off the ordinary line of inspections. Mr. Dick, who superintended it, deserves credit for that. The Contractor was Mr. Michaelidis. There were no difficulties of construction: the foundations, by being carried down about half a metre lower than the design, reached good hard clay, with hardly any extra expense, as the design was modified in such a way as to avoid it.

MAHMUDIA CANAL BRIDGES IN ALEXANDRIA.

The arrangement made some years ago, by which the Alexandria Municipality took charge of the three bridges over the Mahmudia Canal with the obligation to keep them in repair and open them to navigation, has been a most unsatisfactory one in its working; and Government has now decided to take back the bridges into its own keeping, renewing two of them and repairing the third. The first renewal undertaken was that of the "Pont des Ecluses." It was completed in 1901 at a cost of £E.3,250. The bridge is now a thoroughly satisfactory one.

Giza Group of Works.

The Giza group of Irrigation Improvements was carried out partly under the direction of the Inspector of the 3rd Circle, partly under the Director of the Barrage. The sums spent during the year were—

	£E.
By 3rd Circle	14,166
By Barrage	1,783
Total...	15,949

These works constitute part of the programme of improvements that were decided on after the experience gained during the low flood of 1899. The scheme, in general terms, provides for the improvement of the means of filling the hoshas between the railway and the river in west Giza by the construction of head sluices, and of controlling the water after it has entered the hoshas by the construction of regulators and escapes: it also provides for the extension of the Giza Canal to the Um Dinar Hosha, west of the Barrage, by the construction of a culvert under the railway, and a syphon under the Rayyah Behera. The method of working the West Giza main system of basins, which it is proposed to adopt and which the recent alterations were devised to introduce, was described on page 166 of the Report for 1900.

The following is the list of works carried out during 1901 :—

	No.	£E.
Head Sluices, Regulators and Escapes.		
Hosha Gezira Kafr el Turki	2	
,, Kafr Barakat...	1	
,, Makatfia	1	
Tail of Makatfia Canal	1	
Hosha Gezira Bemba	1	
,, Balêda	2	
,, Marazik	2	
,, Tarfaya	1	
,, Gesira Tarfaya	1	
,, Tamoh	2	
,, Geziret el Dahab	2	
	16	7,378
Iron Tube Feeders and Escapes.		
Hosha Gezira, Kafr Rafâi and Mârazik	2	
,, Matânia	2	
,, Gezireh Hawamdia	1	
	5	1,082
Completion of Abu-Nimros syphon and alterations to Zummur Head	2	990

		£E.
Brought forward...		9,450
Conversion to horizontal closure system.		
Agooz Head (formerly Agooz Escape)	1	
Saqqara and Shabramant Salibah regulators	2	
Matânia culvert	1	
	4	2,955
(with this is included expenditure incurred in improving basin and canal banks).		
Road Bridges.		
Over Giza Canal at Ayat and Tamoh...	2	
„ Badala Canal	1	
„ Zummur Canal	1	
	4	827
Fifty-two small pipes and masonry culverts in Giza Canal banks, and new bank to Hosha Tamoh		934
Total 3rd Circle...		14,166
	£E.	
Rayyah Behera syphon	335	
Railway culvert	572	
Connecting channels	876	
Total Barrage...		1,783
Total...		15,949

In 1900 a sum of £E.483 was paid for the pipes of the Rayyah Behera syphon, so that the cost of this work has been £E.818. There are still the masonry ends to be added, which it was thought best to postpone till a flood season had passed, so as to give the tube time to take its final bearing. This syphon is formed of a one and a half metre diameter pipe of $\frac{5}{16}$-inch thickness of mild steel. Its lengths were rivetted together on the bank, and the whole floated into position and lowered into a trench by the help of two large barges, the trench having been previously dredged to correct depths across the bed of the canal. The total length of the pipe is seventy metres and its weight thirty tons.

EARTHWORK IN NEW WORKS AND REMODELLING.

Earthwork in new works and remodelling includes any special remodelling which alters the previously accepted dimensions and levels of a canal, but does not include the ordinary remodelling of canals which is carried out with the object of restoring a neglected canal to its correct section of channel and banks.

In the 1st Circle, funds were provided for the conversion of the Sisa, Marsafawia and the Um Galâgil Canals from "Nili" to "Sefi" canals. These are expensive works as, in the case especially of the first two named, heavy banks have to be moved as a preliminary to deepening the canals, and valuable land has to be expropriated. The expenditure of £E.3,351 in 1901 was for land payments along the Marsafawia and the Um Galâgil canals as a first step towards the conversion, £E.1,405 being for land along the Marsafawia and £E.1,889 for land along the Um Galâgil.

In the 2nd Circle a sum of £E.5,376 was expended in the interests of navigation on widening the reach of the Qodaba canal which connects the Qodaba lock with the Baguria. This portion of the navigable line between Cairo and Alexandria was tortuous and narrow, and presented great inconveniences to navigation, especially as it lay immediately above the tail lock where boats collect while waiting to pass through the lock. The navigation along this line is daily becoming of more importance and, therefore, its improvement as a navigable waterway is most desirable. The widening of this end reach was one of the first improvements called for, and its execution has removed a great defect.

In the 3rd Circle £E.10,227 was expended in widening the Sahel Markas Canal along 10 kilometres of its length, including the construction of new bridges and irrigation outlets. The head reach remains to be widened in 1902, and then this important remodelling work will be complete, whereby the early flood supply of the Mahmudia Canal will be much improved, and the necessity of running the two "Khandaks" at objectionably high levels will be removed. It is hoped also that the annual accumulation of silt in the head reaches of the Mahmudia may diminish as a result of this work.

The remodelling of the Mahmudia Canal banks and the demarcation of the Government boundaries is a work of considerable difficulty on account of the complicated questions of rights of property that arise in the execution of it. A commencement was made and a sum of £E.1,199 expended in 1900. It is hoped that when the advantages of the work are seen and appreciated by the owners of property with whom the difficulties arise, that they will themselves realise that, in their own interests, they should facilitate the carrying out of the work as much possible.

New and Remodelled Drainage Works.

The expenditure on Drainage Works in 1901 in the 1st Circle was much the same as the year before; it was less in the 2nd Circle and considerably less in the 3rd Circle.

In the 1st Circle the expenditure, of which the detail is given in Appendices B and C, amounted to £E.44,668, exclusive of staff charges. The principal works were:—

(1) Continuance of the dredging of the main Bahr el Bagar drain over a length of 10 kilometres.

(2) Prolongation of Bilbeis drain to Birket el Hagg. This was only partly executed. The laying of a pipe syphon under the Ismailia Canal is the principal item of work remaining to be carried out in 1902.

(3) The Shanfas branch of the Nizam-Hadus system was dug for 21 kilometres on the east of the Um Salama Canal.

(4) A new head and connecting channel were dug to give the Gabada canal a direct take-off from the Mansuria Canal, so as to disconnect it from the Um Salama.

The other drains dug are detailed in the appendices and call for no special remarks.

In the 2nd Circle the total expenditure on Drainage Works, new and remodelling, was £E.57,463, exclusive of staff. Details of the work done are given in Appendices D and E. The most important works were on the Sharkawia (No. 4), Waziria (No. 7) and Ariamun (No. 8) systems.

The improvement effected by the drainage works already carried out is very great, but, in the 2nd Circle, much still remains to be done before the system of drains can be said to be approaching completion. At the time when the Caisse began to give money, the drains of Gharbia were in a more backward state than those of the other Circles of Lower Egypt.

Details of the Drainage Works executed in the 3rd Circle are given in Appendices F and G. The total expended on Works, exclusive of staff, was £E.32,037. The work done consisted entirely of remodelling the undeveloped drains of the Mareotis system. The Khandaq Gharbi aqueduct, for which a payment of £E.182 was made, had been built in 1900.

These drains are having a marked effect on large areas in the Abu Hommos and Kafr Dawar districts, which will be ready for reclamation as soon as the Aswan Reservoir adds to our available summer supply for irrigation.

The cubes of earthwork executed during 1901 in new and remodelled Drainage Works are given below:—

	Dredging.	By hand-work.	Totals.	Cost.
	C.M.	C.M.	C.M.	£E.
1st Circle	272,665	1,125,070	1,397,735	27,640
2nd Circle	142,000	1,771,667	1,913,667	37,916
3rd Circle	150,840	931,367	1,082,207	26,659
Totals...	565,505	3,828,104	4,393,609	92,215

Details of the Drainage Works executed will be found in Appendices B to G.

STATEMENT OF LENGTHS OF DRAINS DUG OR REMODELLED AND YEAR'S EXPENDITURE ON DRAINAGE WORKS.

	1ST CIRCLE.			2ND CIRCLE.			3RD CIRCLE.			TOTALS.		
	1897 to 1900	1901	Totals.	1897 to 1900	1901	Totals.	1897 to 1900	1901	Totals.	1897 to 1900	1901	Totals.
	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.
New	407½	89½	497	332	27	359	205½	—	205½	945	116½	1,061½
Remodelling ...	343	15	358	361	104	465	235½	52½	238	912	171½	1,083½
	£E.	£E.	£E.	£E.	£E.	£E.	£E.	£E.	£E.	£E.	£E.	£E.
Expenditure ...	295,951	44,897	340,848	306,414	57,358	363,772	323,518	32,621	356,139	925,883	134,876	1,060,759

SOURCES FROM WHICH FUNDS FOR THIS EXPENDITURE WERE OBTAINED.

YEAR.	From Caisse de la Dette.	From Public Works Budget.	From other sources.	Totals.	REMARKS.
	£E.	£E.	£E.	£E.	
1897	248,019	34,002	3,513	285,534	These figures include staff.
1898	252,700	26,254	—	278,954	
1899	144,773	49,179	—	193,952	
1900	156,173	11,270	—	167,443	
1901	139,012	1,268	—	140,280	
Totals	940,677	121,973	3,513	1,066,163	

CHAPTER VI.

WORKS OF MAINTENANCE AND REPAIRS.

River and Canal Protective Works.

The detail of the expenditure under this head is given below:—

	£E.	£E.
1st Circle.		
River spurs and revetments	6,109	
Rayyah Taufiki spurs	495	
Study for Nile Corvée abolition	181	
		6,785
2nd Circle.		
River spurs and revetments	7,152	
Rayyah Menufia spurs	4,774	
Grass planting canal slopes	1,227	
Study for Nile Corvée abolition	226	
		13,379
3rd Circle.		
River spurs and revetments	7,019	
Grass planting	459	
Study for Nile Corvée abolition	600	
Abukir sea wall	2,030	
		10,108
Barrage.		
River training and protection	2,080	
		2,080
	Total	32,352

The river work on spurs and revetments is the same as usual. The object and result of the expenditure on the study for the Nile Corvée abolition has been explained at the end of Chapter II; and the Barrage river training in Chapter V.

The increase of expenditure on protective works is due to the canal work. It has been found that all the largest canals require some method of protection in their upper reaches to prevent the channel widening and shoaling. Spurs of stone have been successful in the Ibrahimia Canal, and spurs together with grass planting in the Rayyahs Behera and Menufia. The Rayyah Taufiki is to prove no exception. This canal was made in 1888, and was given berms of six metres width.

These berms have now entirely disappeared, and the bed level has begun to rise, but has not yet reached the level at which dredging will be necessary. The berms having disappeared, the high spoil banks behind them have commenced to slip into the channel, and some lengths of this canal have now assumed the appearance of the Ibrahimia Canal as it was in 1884 before any stone spurs were made. It has, therefore, been decided to spur the Rayyah Taufiki at once before the widening goes any further, as very short spurs will now be necessary and a small cube of stone only will be required for each. A commencement was, therefore, made at the end of 1901 with the construction of spurs in the first sandy reach below Kilometre five.

A special grant was given for the Rayyah Menufia spurs, and a considerable amount of spur work was done with highly promising results. The effect of the spurs was assisted by planting the slopes with grasses and willows.

An experiment with grass planting, as a means of producing and maintaining a uniform channel, and preventing widening and consequent shoaling, was carried out with remarkable success on two of the branches taking off from the Rayyah Menufia. Mr. Tottenham, who was specially charged with this work and took great interest in it, conducted the experiment very thoroughly and has the satisfaction of seeing his work followed by highly successful results. The canals experimented on were the Nanaïïa and Sirsawia. Fascines of grass stalks were arranged to form the side slopes of the channel up to H.W.L. to a height of 3 to 3½ metres, and the berms behind them were planted with grasses. These have taken root, and there is now a thick grass jungle bordering the central channel, which has kept its form and depth so perfectly that in 1902 no clearance is necessary along the length so treated, whereas, in former seasons, there was invariably a depth of 1 to 1¼ metres of silt to be cleared. The experiment being of such good promise, the system is to be continued in 1902, and four canals will be operated on.

The maintenance of the Abukir sea wall has become a heavy item of expenditure against the 3rd Circle budget. The original protection work along the sea front was not efficiently done, the stones used being too light to resist the heavy action of the winter storms. The annual repairs will always be heavy, until a protection of a heavier material is laid over the smaller stone. An estimate of the cost of doing this has been called for, but the figure will probably be too great for the ordinary Irrigation budget to support, and the work will not be possible without special funds being granted.

MAINTENANCE.

Masonry Works and Dwelling-houses.

The expenditure under this head (£E.16,268), is almost the same as the year before. The most important single work was the lowering the sill of the Qodaba lock. As built, it was found to cause an obstruction to navigation in the summer months; and, as there was no object in its being kept at a high level, it was lowered one and a quarter metres, and the necessary additions made to the lock gates. This work cost £E.813, including the cost of the dam, dredging and unwatering.

The Barrage repairs and gardens have been referred to in Chapter V.

EARTHWORK BY HAND.

The quantities and cost of earthwork executed by hand during 1901 are as below, the earthwork on agricultural roads being excluded:—

CLASS OF WORK.	1st Circle.	2nd Circle.	3rd Circle.	Totals.
	C.M.	C.M.	C.M.	C.M.
Maintenance Canals, Drains and Banks...	3,372,630	2,700,767	2,121,492	8,194,879
Irrigation Improvements	215,752	210,510	526,895	953,157
New Drainage Works	1,125,070	1,771,667	931,367	3,828,104
Totals...	4,713,452	4,682,934	3,579,754	12,976,140
Cost ... ... £E.	75,098	91,819	69,161	236,078
Rate ... ... P.T.	1·59	1·95	1·93	1·82

DREDGING BY MACHINERY.

The quantities dredged in canals and drains for the past five years are given in the statement which follows. In this table the dredging done as maintenance of existing channels is separated from dredging executed as remodelling work.

CANALS AND DRAINS.	1896-1897	1897-1898	1898-1899	1899-1900	1900-1901
	C. M.	C. M.	C. M.	C. M.	C. M.
1ST CIRCLE.					
Maintenance.					
Ismailia	206,976	224,316	*322,471	225,096	190,799
Sharkawia	113,983	111,946	125,557	77,462	82,647
Basusia	132,263	183,485	152,854	195,969	229,835
Kumbatin	62,293	64,848	51,412	62,504	84,622
Wadi	96,888	—	—	—	—
Bahr Saghir	14,286	50,027	2,823	70,197	32,115
Mansura lock	32,779	15,906	22,648	15,000	21,437
Total Maintenance ..	659,468	650,528	677,765	646,228	641,465
Remodelling.					
Sanaytah lock	—	—	5,353	—	—
Siru drain	—	50,413	—	—	—
Bahr el Bagar drain..	146,830	227,387	245,853	433,640	212,140
Bahr Tawil drain	—	—	116,706	72,944	60,525
Total Remodelling ..	146,830	277,800	367,912	506,584	272,665
Grand Totals	806,298	928,328	1,045,677	1,152,812	914,130
Expenditure .. £E..	29,382	33,490	37,352	40,095	32,560
2ND CIRCLE.					
Maintenance.					
Menufia	198,591	265,069	399,937	255,535	112,567
Kasid	—	112,676	—	138,204	—
Bahr Tirah..	—	—	74,810	5,959	—
Qodabah lock	11,577	6,979	10,530	5,512	13,363
Baguria	—	—	—	4,424	2,380
Total Maintenance ..	210,168	384,728	485,277	409,634	128,310
Remodelling.					
Muhit drain (No. 1)..	242,721	218,298	84,000	—	142,000
Demillash drain	—	—	114,000	87,183	—
Total Remodelling ..	242,721	218,298	198,000	87,183	142,000
Grand Totals	452,889	603,022	683,277	496,817	270,310
Expenditure .. £E...	16,078	21,395	23,279	17,110	9,367
3RD CIRCLE.					
Maintenance.					
Ray. Behera & Katatba canal.	139,275	230,916	185,982	136,516	149,915
Mahmudia canal	118,464	120,996	123,434	117,530	159,921
Mex pumps inlet channels ..	6,939	11,006	—	—	—
Nubaria canal	59,615	—	37,980	17,843	—
Total Maintenance ..	324,293	362,918	347,396	271,889	309,836
Remodelling.					
Sahel Markaz canal..	—	7,652	54,398	—	—
Difishu drain	8,558	—	5,863	—	—
Shereshra drain	7,600	—	—	—	—
Edku drain	—	142,289	256,967	16,834	—
Umum drain	—	18,500	—	99,230	150,840
Mahmudia Special	—	—	—	82,633	—
Total Remodelling ..	16,158	168,450	317,228	198,697	150,840
Grand Totals	340,451	531,368	664,624	470,586	460,676
Expenditure .. £E...	12,044	19,561	21,876	17,033	15,663

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*The Ismailia cube for 1898-1899 includes 60,000 cubic metres executed the year before in the Suez branch but not paid for.

The totals for 1901, abstracted from these tables, are:—

DREDGING ON ALL ACCOUNTS.	1st Circle.	2nd Circle.	3rd Circle.	Totals.
	C.M.	C.M.	C.M.	C.M.
Maintenance Canals and Drains.	641,465	128,310	309,836	1,079,611
New Drainage Works	272,665	142,000	150,840	565,505
Totals...	914,103	270,310	460,676	1,645,116
Cost... ... £E.	32,560	9,367	15,663	58,590

HAND WORK AND DREDGING.

Abstracting all the foregoing, we get the following total figures for 1901:—

HAND WORK.	Cubic metres.	Cost £E.
Maintenance of Banks, Canals and Drains ...	8,194,879	—
Irrigation Improvements	953,157	—
New Drainage Works	3,838,104	—
Totals...	12,976,140	236,076
DREDGING.		
Maintenance of Canals and Drains	1,079,611	—
New Drainage Works	565,505	—
	1,645,116	57,590
Total hand work and dredging...	14,621,256	293,668

The Table of dredging cubes for the past five years shows what a remarkable decrease there has been in the maintenance dredging cubes of the 2nd Circle. This is partly due to the action of the spurs and grass planting in the Rayyah Menufia in preventing silt deposit. But it is also partly due to the fact that small deposits, which in previous years would not have been left undredged for fear of diminishing the summer discharge, can now be safely ignored, as the summer discharge can be adjusted by regulation on the head works of the canals which take off from the river above the Barrage. The security afforded by the new Weirs enable us to produce above the Barrage as high a level as we are ever likely to want for purposes of distribution, without any fear for the Barrage, so that the effect of any slight obstructions in the canal beds can be neutralised by regulation on this group of head works. So long as the early flood discharges are not appreciably diminished by the unremoved silt deposits, they can do no harm.

Concerning this question, Mr. Dupuis, referring to the Menufia Canal, makes the following remarks in his Report:—

"It must not, however, be forgotten that much of this apparent economy is obtained by simply leaving work, which used to be considered necessary, undone; if, as is not impossible, it is found that, after the bed has risen a little and adjusted itself to the new conditions, the silt ceases to accumulate, a great and permanent reduction in the annual maintenance expenditure will have been effected; if, on the other hand, the accumulation continues, it will simply mean a return to the old cubes on a slightly different bed plane."

But there are two contemplated changes which encourage the expectation that the economy will be permanent. The first is a consequence of the construction of the Zifta Barrage. When that work is in operation in 1903, the early flood supply of the north-east of the Central Delta will be drawn from the river by way of the new Zifta Canal, and the Rayyah Menufia discharge will not require to be supplemented by the opening of the Bir Shams Feeder. It is this proceeding which doubtless is accountable for no insignificant quantity of silt deposit in the canal bed; certainly for the lump which forms above the point were this feeder joins the main canal.

The other contemplated change will be brought about by the execution of the project for the development of the West and East Nili canals on either side of the Rayyah Menufia, which have their heads above the Barrage. By enlarging these canals and carrying them in syphon under the Menufia branches, and joining them up with all the flood canals wich serve the high country lying between the two branches of the river for some 25 kilometres north of the Barrage, the necessity of regulating on the Nanaïïa and Qaranên regulators will cease, and another cause of silt deposit be avoided. The Caisse de la Dette has given £E.10,000 in 1902 for the commencement of this project, which is a somewhat comprehensive one and will probably take three years to complete. Not only will its execution favour the endeavours being made to reduce the dredging expenditure, while, at the same time, immensely improving the conditions of the high lands affected as regards their irrigation; but, by rendering it unnecessary in the future to regulate on the Nanaïïa and Qaranên bridges, it will remove the necessity of enlarging the locks at these two regulators with the object of making them equal in length to the other locks on this line; and so an economy of the cost of these two expensive and difficult works will be effected, as the two locks can remain permanently open, and so render the deficiency in the lengths of their chambers between the gates of no account.

The second of the causes given as accounting for part of the economy realised in maintenance-dredging in the 2nd Circle should also have produced a similar effect in the 1st and 2nd Circles. But there is none evident in the figures. The level to which the Ismailia Canal has to be dredged was in 1901 raised 20 centimetres, and in consequence there is a small reduction in the cube in the case of this canal. But in the Sharkawia, Basusia and Kumbatin, there are increases which more than counter-balance the Ismailia decrease. The bed level to which dredging is to be carried in the Ismailia Canal has been raised a further 25 centimetres in 1902, which should result in economy. In the 3rd Circle also a reduction in the cube dredged is expected in 1902.

Mr. Dupuis, Inspector of the 2nd Circle, has turned his attention to a matter which requires a great deal more attention than Inspectors have hitherto found time to give to it. Much useless work is done in clearing canals in the northern districts of the Delta in consequence of the inefficiency and defective common sense of the majority of the Provincial Engineers. Instead of these clearances, what is wanted are repairs to banks and maintenance of the banks, as the channel is generally sufficient, and, on the lower reaches and branches of the canal system having its origin at the Barrage, there can be no question of the power to obtain whatever level may be necessary to make the water flow forward. If all useless work on canal clearances could be eliminated, there would remain large sums available for the clearances of drains and the remodelling of canal banks. Inspectors of Irrigation have had their attention called to this.

CHAPTER VII.

COMMUNICATIONS.

AGRICULTURAL ROADS.

Construction of new Roads.

The annual progress statement is given below:

CIRCLE AND PROVINCE.	Existing at end of 1900.	Added during 1901.	Total at end of 1901.	Expenditure 1901.
	Kilom.	Kilom.	Kilom.	£E.
1st Circle.				
Galiubia	107	—	107	7,114
Sharkia	202½	—	202½	
Dakahlia	203½	—	203½	
2nd Circle.				
Menufia	279	—	279	10,647
Gharbia...	692	17	709	
3rd Circle.				
Behera	281½	—	281½	373
Totals...	1,765½	17	1,782½	18,134

Of this expenditure, a sum of £E.248 for land in Behera was charged to the Regular Budget, so that the expenditure of the year against the Road collections was £E.17,886 and not £E.18,134.

The reason why so small progress is shown for the sum expended is that the expenditure in the 1st and 2nd Circles was for completing the payments on roads which were shown as added in 1900. The sum expended on Behera Roads was in settlement of some claims for land payments of long standing, which should have been wholly met from road collections. As the Mudir was unable to collect the sums required, the settlement was arranged for by making a contribution from the Irrigation Budget. The same occurred in 1900. Some years ago also the Budget had to make good heavy deficits in the Behera collections to meet the cost of its roads.

MAINTENANCE OF ROADS.

The Irrigation Budget provided also £E.3,082 for repairs to the 1,765 kilometres of roads existing at the end of 1900, a quite insufficient sum to keep the roads in order. I need not repeat the remarks on this subject made in the three preceding yearly Reports. This expenditure was divided as below:—

	Kilom.	£E.
1st Circle	513	1,432
2nd "	971	1,229
3rd "	281	500

The 2nd Circle's expenditure included a sum of £E.423 spent on special repairs to the Belkas-Salahib road, which was in a particularly bad state.

The 1st Circle expenditure of P.T.279 a kilometre was sufficient to keep the roads in a condition which might be called a tolerable state of repair: the 2nd Circle rate of under P.T.126 a kilometre is wholly insufficient. The reason for the failure to maintain the roads as they should be maintained is the want of special funds for the purpose.

BRIDGES TO REPLACE FERRIES.

The year's expenditure amounted to a total of £E.4,897, but of this amount of £E.1,923 was contributed by the State Railway Administration in fulfilment of their obligations connected with an agreement made some years ago. There was also a further sum of £E.345 which was subscribed towards the Melig bridge by the villagers interested.

The 1st Circle bridges were put in hand late in the year, so that only a small payment was made on account of them.

The bridges taken in hand or constructed are detailed below:—

			Expenditure, 1901. £E.
1st Circle.			
At Abbasa, over Ismailia Canal (estimated cost £E.1,260.) At Nawasa el Ghêt, over Mansuria Canal (estimated cost £E.1,685.)			300
2nd Circle.			
Melig bridge. ...	Ferry Fund.	2,144	
	Village contribution..	345	
			2,489
Santa bridge ...	Ferry Fund.	170	
	State Railway contribution ...	800	
			970
Dalgamun bridge.	Ferry Fund.	306	
	State Railway contribution ...	1,132	
			1,438
		Total	£E.5,197

The Dalgamun bridge cost about £E.4,000, but the balance was paid by the Light Railway Company, which will share the use of the bridge with the general road traffic.

Against the Ferry Fund, therefore, the expenditure was only £E.2,920 for both the 1st and 2nd Circles. There was no expenditure against this fund in the 3rd Circle.

CHAPTER VIII.

THE WADI TUMILAT.

The management of this estate by Mr. Langley and Musa Bey Galeb continues to give satisfactory results. A sum of £E.9,481 was spent during 1901 on works of improvement and reclamation against the capital account, which stood at the end of the year as in the following statement:—

Heads of Expenditure.	Original Estimate.	Expenditure.	
		During 1901.	Total to end of 1901.
	£E.	£E.	£E.
Drainage and Reclamation Works.			
Enlargement of pumping station	6,000	—	3,488
Enlargement of main drain	17,000	1,645	11,749
Branch and field drains and field channels ...	15,189	3,828	5,925
Remodelling Irrigation System.			
Wooden bridges and pipe heads	—	787	—
Four head sluices, Three regulators and One mansory bridge	—	1,076	—
Two flour mills	—	110	—
Earthwork of irrigation channels	—	467	—
Purchase of Plant.	10,000	2,440	7,781
Pump dredger installation	2,500	195	1,909
Staff and Farm Buildings.			
Ezbas	—	115	
Houses and store	—	432	
Steam Ploughing, Staff and Sundries.	8,500	547	2,483
Pay of staff and travelling allowances... ...	—	558	—
Ploughing	—	268	—
	3,000	826	1,774
Totals...	62,819	9,481	35,109

In 1899 a further sum of £E.425 for pumping at Kassassin was wrongly charged to capital account instead of against revenue.

The enlargement of the main drain above the pumps is now complete, and the drain working well.

A length of 17 kilometres of the old stagnant reed-choked Wadi Canal has been suppressed and its place taken by two small canals taking off direct from the Ismailia Canal with proper head sluices and regulators. On one of these regulators two flour mills have been erected. The water supply to the estate is now completely under control.

A new boiler for the pumping station and a sand dredger for the main drain have been ordered.

The revenue accounts shows a surplus of £E.723, the receipts being £E.21,132 and the expenditure £E.20,409.

The receipts and expenditure are thus made up:—

		£E.
Receipts.	Rent of 12,327 feddans	20,115
	„ of palm trees	315
	„ of grazing and wild "Samar"	514
	„ of incubator	20
	Flour mills	103
	Sundry	71
	Total...	£E.21,138
Expenditure.	Staff	2,043
	Taxes	5,827
	Payment to Ministry of Public Instruction	8,000
	Working expenses of pumping station	3,961
	Canal and drain maintenance	482
	Petty expenses	105
	Total...	£E.20,418

The high price of coal continued to affect the working expenses of the pumping station at Kassassin.

For the sake of comparing the actual results obtained with the forecast made before taking over the management of the Estate, the following Table is given:—

Year of new Management.		Expenditure.	Receipts.	Surplus.	Deficit.
Original forecast	1st ...	19,350	15,710	—	3,460
	2nd ...	19,350	17,200	—	2,150
	3rd ...	19,350	19,700	350	—
Actual results obtained ...	1899...	15,827	16,025	198*	—
	1900...	19,643	19,957	314	—
	1902...	20,418	21,138	720	—
	Total of...		...	1,232	—

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* This surplus was scarcely a bonâ fide one, as it was obtained by charging by £E.1,224, the cost of pumping, to the Public Works Budget in the early part of the year before the new arrangement had been concluded.

A sum of £E.1,117, out of the surplus total of £E.1,232. was used to purchase $63\frac{1}{3}$ feddans of scattered plots of Government land which it would have been undesirable that outsiders should possess on account of their situation in the middle of the Wadi lands. There is, therefore, a surplus balance remaining of £E.115.

The total area leased is the best measure of the reclamation effected: the figures are given below with the forecast figures for comparison:—

		Actually leased.	Forecast.
1898... ...	Feddans	6,917	8,080
1899... ...	„	7,578	8,000
1900... ...	„	9,382	9,000
1901... ...	„	12,337	10,000
1902... ...	(estimated	14,040)	11,000

All rents due for 1901 have been paid.

The crops raised were all good except the cotton which, according to Mr. Langley's statement, suffered from fogs. The "Samar" crop covered 2,400 feddans, but the price was low in consequence of the large area planted. The demand for it must be very limited. There was an area of 1,900 feddans under rice. At the agricultural show, the Estate had eight exhibits and obtained seven awards, including a first prize for "Samar" mats and a bronze medal for cotton.

The flour mills, worked by water power as in the Fayum, have proved remunerative. The two erected in 1900, at a cost of £E.123, brought in £E.79 during 1901. The two erected in 1901, at the same cost, earned £E.16 in six weeks' working.

The expenditure on pumping was £E.3,961. Mr. Langley thinks this figure will not be exceeded in future. The price of coal and the high lift are given as the causes of the high expenditure. The lift in 1901 was increased by the bad state of the outfall drain which is now being dredged. The dredging has effected a reduction of the fall in the water slope over the 6 kilometres between the pumps and Mahsama lake from 1·60 metres to 0·60, and a further reduction is still probable as the dredging proceeds. The quantity of coal consumed increases with the lift. Unfortunately there are no records of quantities pumped. The following figures may be worth recording.

YEAR.	Mean lift.	Coal consumed.	Price of coal per ton.	Total expenditure including Staff.
	Metres.	Tons.	Tons.	£E.
1898	1·43	403	1·411	1,330
1899	1·66	441	1·280	1,224
1900	2·84	1,000	2·430	3,230
1901	3·20	1,753	1·876	3,961

CONCLUSION.

Changes in the Staff.

Early in May 1901, Mr. W. R. Williams arrived from India, and took charge of the 3rd Circle as Inspector.

Mr. O. G. Brooke, Director of the Barrage, retired from the Egyptian Service in November, and was succeeded at the Barrage by Mr. H. G. Finlaison on 1st December.

The Barrage Directorate has since been made a more important charge by the addition to it of Giza Province, which has been detached from the 3rd Circle. The change took place from 1st January, 1902.

The dredging of the Rayyah Behera throughout, together with the care of the spurs flanking the channel, and the River Protective Works up to the Barrage still remain in the charge of the Inspector of the 3rd Circle, but with these exceptions the whole of the Giza Province and the works that lie in it have been placed in the charge of the Director of the Barrage. There are obvious advantages in this arrangement. The Barrage is a much more convenient point than Alexandria from which to control the works and irrigation operations in the Giza Province. The Province of Behera provides enough work for one man to attend to; and now that all the remodelling of the Barrage itself and of its groups of regulators is approaching completion, the Director of the Barrage would find that he had not enough to occupy him, if no addition had been made to his duties.

Mr. F. A. Hurley had been placed in charge of the construction of Zifta Barrage towards the end of the year 1900 and was in sole charge of the works throughout the year 1901.

During the year, Hassan Bey Wassif, the Chief Engineer of Menufia died, and his place was taken by Muhammed Bey Shukri.

Mr. Langley, Inspector of Irrigation, 1st Circle, fell ill during the flood season of 1900, so that he had to take a short leave at the end of that year and again long leave in 1901, from which is resulted that, for the greater part of the 12 months between the two floods of 1900 and 1901 and for the whole period of the flood of 1901, Mr. Molesworth directed the Circle. The satisfactory yield of the cotton crop testifies to his having efficiently controlled the distribution of water during the summer months of short supply when rotations were in force and he was acting Inspector of Irrigation.

R. H. BROWN.

APPENDICES.

APPENDIX A.

ABSTRACT OF ACCOUNTS, 1901—IRRIGATION DEPARTMENT, LOWER EGYPTE.

BUDGET HEAD.	1st Circle.	2nd Circle.	3rd Circle.	Barrage.	Zifta Barrage.	TOTALS.
	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.
REGULAR BUDGET.						
Establishment.						
Classified staff	8,788.620	7,904.467	8,705.665	973.166	—	26,371.918
Unclassified staff	4,359.946	4,109.560	3,351.855	3,170.544	—	14,991.905
Travelling charges.	2,387.535	3,556.779	3,050.000	48.015	—	9,042.329
Telegrams	231.299	236.795	179.960	9.735	—	657.789
Dahabiyas	366.400	—	156.000	—	—	522.400
Office charges and furniture ...	535.263	303.320	327.852	14.130	—	1,180.565
Works.						
Irrigation improvements	10,711.068	7,837.013	4,998.719	6,700.000	—	30,246.800
Flood protection works	6,364.720	7,152.176	5,249.545	—	—	18,766.441
Maintenance and repairs	5,050.715	4,339.415	2,366.165	13,276.520	—	25,032.815
Repairs of roads...	1,353.068	805.587	500.000	—	—	2,658,655
Pumping stations	—	—	12,709.330	—	—	12,709.330
Corvée abolition works	30,029.000	22,266.445	19,602.930	—	—	71,898.375
Totals, Regular Budget.. ...	70,177.634	58,511.557	61,198.021	24,192.110	—	214,079.322
Corvée abolition	46,000.000	41,999.393	33,999.310	—	—	121,998.703
Agricultural Roads	7,113.903	10,629.448	124.804	—	—	17,868.155
Bridges to replace ferries	300.000	2,619.853	—	—	—	2,919.853
SPECIAL GRANTS BY CAISSE FROM GENERAL RESERVE.						
Drainage works...	47,579.729	58,816.316	32,615.710	—	—	139,011.755
Irrigation improvements	27,009.238	17,795.301	42,323.171	33,711.206	—	120,838.916
Special Low Nile credit	578.368	554.470	5,146.979	150.627	—	6,420.444
Mehallet El Amir dam	—	—	8,187.448	—	—	8,187.448
Damietta dam	4,745.891	—	—	—	—	4,745.891
Special Dredging Mahmudia ...	—	—	1,117.818	—	—	1,117.818
Weirs below the Delta Barrage.	—	—	—	8,321.810	—	8,321.810
Zifta Barrage	—	—	—	—	121,059.338	121,059.338
Totals, other credits... ...	133,327.129	132,404.781	123,515.240	42,183.643	121,059.338	552,490.131
Grand Totals... ...	203,504.763	190,916.338	184,713.261	66,375.753	121,059.338	766,569.453

APPENDIX B.

Abstract of Drainage Works executed in 1901 in 1st Circle.

Name of Drain.	Length in kilom.		Earthwork.			Land cost.	Expenditure on works.	Total Expenditure.
	New channel.	Remodelled channel.	Dredging.	Hand-work.	Cost.			
			C.M.	C.M.	£E.	£L.	£E.	£E.
Bahr el Bagar System.								
Main drain...	—	10	212,140	—	7,213	34	—	7,247
Bilbeis branch	22½	—	—	260,000	6,500	—	1,702	8,202
Tahawi branch	5	—	—	50,155	803	—	326	1,129
Arin San System.								
Main drain...	Balance for work done in 1900. ...					—	—	1,089
Arin east branch	8	—	—	335,724	4,868	362	2,671	7,901
Um Shok branch	3½	3	—					
Abu Yassin branch	4¾	—	—					
Bahr Saft System.								
Sudds branch	6½	—	—	95,770	1,220	340	1,447	3,007
Nizam Hadus System.								
Main Bahr Tawil	—	2	60,525	—	2,058	—	9	2,067
Mansura branch	Balance for work done in 1900. ...					—	—	394
	Railway diversion.					—	34	34
Shunfas branch...	21	—	—	242,747	3,155	1,266	1,659	6,080
Kafr Beni Salem branch...	9¼	—	—	71,778	933	320	730	1,983
Gabada Canal	—	—	—	32,736	410	250	732	1,392
Irrigation works	—	—	—	—	—	—	1,173	1,173
Siru System.								
Neghir drain	9	—	—	36,160	480	37	20	537
Miscellaneous.								
Cost of land occupied previous to 1901	—	—	—	—	—	2,407	—	2,407
Boundary stones for drains	—	—	—	—	—	—	255	255
Totals	89½	15	272,665	1,125,070	27,640	5,016	10,758	44,897

APPENDIX C.

Detail of Expenditure on Works.

Name of Drain.	Description of Work.	Expenditure.	Totals.
		£E.	£E.
Bahr el Bagar System.			
Bilbeis branch	Bilbeis syphon, on account	500	
	Pipes, on account	1,202	1,702
Tahawi branch	8 pipes	236	
	6 wooden bridges	90	326
Arin San System.			
Arin East branch	34 pipes	1,903	
Um Shok branch	28 wooden bridges	700	
Abu Yassim branch	18 kilometre marks	8	
Main drain	263 boundary stones	60	2,671
Bahr Saft System.			
Sudds branch	5 regulators	903	
	13 wooden bridges	234	
	68 boundary stones	16	
	Pipes	294	1,447
Nizam and Hadus System.			
Main Bahr Tawil	Pipes	—	9
Mansura branch	Railway diversion	—	34
Shumfas branch	1 Agricultural road bridge	348	
	122 boundary stones	29	
	Pipes, paid on account	952	
	22 wooden bridges	330	1,659
Kafr Beni Salem branch	Pipes, paid on account	476	
	66 boundary stones	14	
	16 wooden bridges	240	730
Gabada.	1 wooden bridge	17	
	Head regulator	715	732
Irrigation works.	1 regulator head to Galia canal	407	
	1 regulator on Orman canal	241	
	1 escape at tail of Orman	162	
	1 regulator at head of Baklia	363	1,173
Siru System.	£E.		
Neghir drain	26 pipes (estimate) 863		
	13 wooden bridges 104		
	967		
	Deduct balance to be paid 947		20
	1076 boundary stones	—	255
	Total		10,758

APPENDIX D.

ABSTRACT OF DRAINAGE WORKS EXECUTED IN 1901 IN THE 2ND CIRCLE.

NAME OF DRAIN OR IRRIGATION CHANNEL.	Length in kilometres.		Earthwork, including dredging.		Land acquired.		Expenditure on works.	Total Expenditure.
	New channel.	Remodelled channel.	Cube.	Cost.	Area.	Cost.		
				£E.	Feddans.	£E.	£E.	£E.
BAHR SHIBIN SYSTEM.								
Muhit drain (No. 1)	—	5	142,000	4,828	—	—	—	4,828
Demellash drain (No. 2)	—	—	—	—	—	—	44	44
SHARKAWIA SYSTEM.								
Sharkawia drain (No. 4)	—	39·6	676,486	12,177	—	—	2,715 1,268	16,160
Sharkawia branch drain	—	14·3	98,401	1,476	—	—	376	1,852
Behut drain	12·6	—	102,121	1,430	11	18	1,603	3,033
Biela Gharbi drain	—	6·4	23,659	402	—	—	178	580
Biela Sharki drain	—	5·5	17,554	281	—	—	216	497
BAHR MALLAH SYSTEM.								
Ibshan drain, east branch (No. 5)	7	—	56,804	823	5	77	1,229	2,052
Samatay drain	—	—	—	—	—	—	723	723
WAZIRIA SYSTEM.								
Waziria drain (No. 7)	—	18	448,299	10,311	—	—	1,075	11,386
ARIAMUN SYSTEM.								
Ariamun drain (No. 8)	—	15	273,633	5,067	—	—	1,036	6,103
Shalma Canal	—	—	—	—	—	—	140	140
Ariamun Canal	—	—	—	—	—	—	122	122
NASHART SYSTEM.								
Wustani drain	7·2	—	74,710	1,121	—	—	353	1,474
Kalline diversion	—	—	—	—	—	—	164	164
Um Yusef drain (No. 9)	—	—	—	—	—	—	292	292
Um Yusef culvert	—	—	—	—	—	—	3,358	3,358
Pipes on Hod El Nagar drain	—	—	—	—	—	—	561	561
Abu Eid syphon	—	—	—	—	—	—	83	83
SUNDRIES.								
Land occupied but not paid for previous to 1901	—	—	—	—	112	2,880	—	2,880
Boundary stones	—	—	—	—	—	—	—	369
Kilometre marks	—	—	—	—	—	—	—	29
Staff and general expenses	—	—	—	—	—	—	—	3,250
TOTALS	26·8	103·8	1,913,667	37,916	128	2,975	15,536	59,980

APPENDIX E.

DETAIL OF "EXPENDITURE OF WORKS" COLUMN OF PRECEDING TABLE.

NAME OF DRAIN OR IRRIGATION CHANNEL.	DESCRIPTION OF WORK.	EXPENDITURE.	TOTAL.
		£E.	£E.
BAHR SHIBIN SYSTEM.			
Demellash drain (No. 2)	Protecting Demellash drain from sand-dunes (part payment)	44	44
SHARKAWIA SYSTEM.			
Sharkawia drain (No. 4) ...	29 W.I. pipes and syphons	1,572	3,983
	11 timber bridges	1,143	
	Water transport (part payment)	1,268	
Sharkawia branch drain ...	5 W.I. pipes and syphons...	200	376
	4 timber bridges...	176	
Behut drain	34 W.I. pipes and syphons	1,235	1,603
	11 timber bridges	368	
Biela Gharbi drain	3 W.I. pipes and syphons	83	178
	3 timber bridges...	95	
Biela Sharki drain	8 W.I. pipes and syphons	113	216
	4 timber bridges...	103	
BAHR MALLAH SYSTEM.			
Ibshan drain east branch (No. 5)	2 masonry aqueducts...	146	1,229
	27 W.I. pipe aqueducts and syphons ...	881	
	7 timber bridges...	202	
Samatay drain	53 wooden bridges	723	723
WAZIRIA SYSTEM.			
Waziria drain (No. 7)	5 timber bridges...	807	1,075
	4 W.I. pipe aqueducts and syphons ...	268	
ARIAMUN SYSTEM.			
Ariamun drain (No. 8)... ...	4 timber bridges...	459	1,036
	3 W.I. pipe aqueducts and syphons... ...	577	
	Carried over...		10,463

DETAIL OF "EXPENDITURE OF WORKS" COLUMN OF PRECEDING TABLE—*(concluded)*.

NAME OF DRAIN OR IRRIGATION CHANNEL.	DESCRIPTION OF WORK.	EXPENDITURE.	TOTAL.
		£E.	£E.
	Brought forward...		10,463
Shalma Canal	1 masonry head sluice (part payment) ...	140	140
Ariamun Canal	1 masonry head sluice (part payment) ...	122	122
NASHART SYSTEM.			
Wustani drain	5 timber bridges...	166	
	3 W.I. pipe aqueducts and syphons... ...	184	
	7 kilo posts	3	353
Kalline diversion	Laying rails for Kalline and Nashart diversions (by the Railway Administration)	164	164
Um Yusef drain (No. 9)	2 timber bridges...	292	292
Um Yusef culvert...	1 masonry culvert carrying Um Yusef drain	3,358	3,358
Pipes on Hod El Nagar drain ...	W.I. pipes from Arsenal for the Hod El-Nagar drain	561	561
Abu Eid syphon	Syphon at No. 9 drain carrying Abu Eid Canal	83	83
	TOTAL...		15,536

APPENDIX F.

ABSTRACT OF EXPENDITURE ON DRAINAGE WORKS EXECUTED IN 1901 IN 3RD CIRCLE.

NAME OF DRAIN.	Length in kilometres.		Earthwork including dredging.		Land.			Expenditure on works.	Total Expenditure.
	New.	Remodelled.	Cube.	Cost.	Area purchased.		Cost.		
			C.M.	£E.	F.	K.	£E.	£E.	£E.
EDKU SYSTEM.									
Khandaq Gharbi	—	—	—	—	—	—	—	182	182
MAREOTIS SYSTEM.									
Umum	—	8	360,106	9,423	—	—	—	375	9,798
Nubaria	—	17½	201,940	4,241	—	—	—	839	5,080
Gabares	—	14½	159,200	3,686	—	—	—	799	4,485
Desunes	—	—	18,560	355	—	—	—	449	804
Deshuri	—	12½	191,561	3,831	—	—	—	1,155	4,986
Iron bridge, Mex pumps... ...	—	—	—	—	—	—	—	2,660	2,660
MISCELLANEOUS.									
Surveying	—	—	—	—	—	—	—	—	1,253
Payments for lands occupied by drains made in preceding years.	—	—	—	—	126	13	2,795	—	2,795
Totals	—	52½	931,367	21,536	126	13	2,795	6,459	32,043

APPENDIX G.

DETAIL OF "EXPENDITURE ON WORKS" COLUMN OF PRECEDING TABLE, 3rd CIRCLE.

NAME OF DRAIN.	DESCRIPTION OF WORK.	EXPENDITURE.	TOTAL.
		£E.	£E.
Khandaq Gharbi	1 aqueduct	182	182
Umum	2 aqueducts...	78	
	2 road bridges	152	
	3 pipe inlets	145	375
Nubaria	7 aqueducts	210	
	4 road bridges	203	
	5 pipe inlets	90	
	1 syphon	336	839
Gabares	7 road bridges	403	
	Pipe inlets	396	799
Desunes	Culvert under railway	449	449
Deshuri	8 road bridges	513	
	16 pipe inlets	642	1,155
Mex pumps inlet channel ...	Iron bridge	2,660	2,660*
	Total...		6,459

* Half of the cost of this bridge was paid by the Daira Khassa, as the bridge was designed to carry its railway.

APPENDIX H.

Nile Gauges for the Year 1901.

Date.	January. Aswân.	January. Barrage Rosetta.	February. Aswân.	February. Barrage Rosetta.	March. Aswân.	March. Barrage Rosetta.	April. Aswân.	April. Barrage Rosetta.	May. Aswân.	May. Barrage Rosetta.	June. Aswân.	June. Barrage Rosetta.
	P. K.	U. S.	P. K.	U. S.	P. K.	U. S.	P. K.	U. S.	P. K.	U. S.	P. K.	U. S.
1	5 5	13·79	3 19	13·21	2 14	14·00	1 10	14·00	0 21	13·95	1 10	13·73
2	5 4	13·76	3 17	13·22	2 13	14·14	1 10	14·00	0 20	13·92	1 10	13·73
3	5 3	13·75	3 16	13·22	2 13	14·25	1 10	14·00	0 19	13·90	1 9	13·74
4	5 3	13·73	3 15	13·21	2 12	14·25	1 10	14·00	0 18	13·88	1 9	13·76
5	5 3	13 69	3 13	13·50	2 11	14·25	1 9	14·00	0 18	13·87	1 9	14·78
6	5 2	13·66	3 12	13·70	2 11	14·25	1 9	14·00	0 17	13·85	1 8	13·79
7	5 1	13·65	3 11	13·50	2 10	14·25	1 8	14·00	0 17	13·81	1 8	13·80
8	5 0	13·62	3 10	13·48	2 9	14·25	1 7	14·00	0 17	13·78	1 7	13·83
9	4 23	13 60	3 9	13·50	2 8	14·25	1 7	14·00	0 17	13·75	1 5	13·85
10	4 21	13 59	3 8	13·50	2 7	14·25	1 6	14·01	0 17	13·71	1 4	13·86
11	4 20	13·57	3 8	13·60	2 6	14·25	1 6	14·05	0 18	13·69	1 4	13 86
12	4 18	13 56	3 8	13·70	2 4	14·25	1 6	14·06	0 18	13·67	1 3	13·87
13	4 17	13·55	3 7	13·80	2 3	14·25	1 5	14·06	0 19	13·66	1 2	13·86
14	4 16	13 57	3 6	13·80	2 2	14·25	1 4	14·05	0 20	13·65	1 2	13·86
15	4 15	13·55	3 4	13·80	2 1	14·25	1 3	14·09	0 22	13·64	1 2	13·86
16	4 14	13·53	3 2	13·90	2 0	14·23	1 3	14·12	1 0	13·64	1 2	13·83
17	4 13	13·54	3 1	14·00	1 23	14 22	1 2	14·16	1 2	13·64	1 3	13·81
18	4 12	13·51	2 23	14·00	1 22	14·15	1 2	14·20	1 3	13·65	1 4	13·79
19	4 11	13·47	2 22	14·00	1 22	14·11	1 2	14·21	1 4	13·64	1 5	13·78
20	4 11	13·44	2 21	14·00	1 21	14·07	1 2	14·23	1 5	13·62	1 6	13·75
21	4 10	13·36	2 21	14·00	1 21	14·00	1 2	14·24	1 7	13 62	1 7	13·69
22	4 9	13·33	2 21	14·00	1 20	14·00	1 2	14·23	1 8	13·62	1 9	13·66
23	4 8	13·32	2 20	14·00	1 19	14·00	1 2	14·22	1 8	14·62	1 11	13·63
24	4 8	13·30	2 20	14·00	1 18	14·00	1 1	14·19	1 9	13·62	1 12	13·62
25	4 7	13·29	2 19	14·00	1 17	14·00	1 1	14·19	1 10	13·62	1 13	13·60
26	4 5	13·27	2 18	14·00	4 16	14·00	1 0	14·19	1 10	13 63	1 16	13·58
27	4 2	13·32	2 17	14·00	1 15	14·00	0 23	14·13	1 11	13·65	1 18	13·50
28	4 0	13·28	2 15	14·00	1 14	14·00	0 23	14·06	1 12	13·67	1 23	13·60
29	3 22	13·27	—	—	1 13	14·00	0 23	14·01	1 13	13·68	2 3	13·60
30	3 21	13·24	—	—	1 12	14·00	0 23	13·99	1 12	13·70	2 5	13·61
31	3 20	13·22	—	—	1 11	14·00	—	—	1 10	13·72	—	—

Date.	July. Aswân.	July. Barrage Rosetta.	August. Aswân.	August. Barrage Rosetta.	September. Aswân.	September. Barrage Rosetta.	October. Aswân.	October. Barrage Rosetta.	November. Aswân.	November. Barrage Rosetta.	December. Aswân.	December. Barrage Rosetta.
	P. K.	U. S.	P. K.	U. S.	P. K.	U. S.	P. K.	U. S.	P. K.	U. S.	P. K.	U. S.
1	2 6	13·63	8 18	15·50	15 7	16·22	13 17	16·25	8 21	15·50	6 11	14 18
2	2 11	13·64	8 21	15·50	15 5	16·21	13 12	16·18	8 16	15·50	6 10	14·18
3	2 19	13·64	9 0	15·50	15 8	16·19	13 6	16·17	8 14	15·50	6 7	14·18
4	3 2	13·64	9 5	15·50	15 16	16·19	13 0	16·14	8 12	15 50	6 7	14·13
5	3 8	13·64	9 13	15·50	15 22	16·18	12 20	16·12	8 12	15·50	6 5	14·16
6	3 12	13·67	10 5	15·50	16 1	16·16	12 15	16·08	8 11	15·50	6 2	14·18
7	3 14	13·71	11 8	15·50	16 1	16·16	12 10	16·01	8 9	15·50	6 1	13·95
8	3 17	13·75	12 8	15·50	15 22	16·20	12 6	15·96	8 8	15·50	6 0	13·92
9	3 20	13·81	12 20	15·50	15 21	16·26	12 2	15·93	8 6	15·50	5 23	13·96
10	4 3	13·87	13 2	15·50	15 20	16·33	11 22	15 86	8 3	15·50	5 22	14·11
11	4 41	13·94	13 8	15·50	15 19	16·38	11 17	15·77	8 0	15·50	5 21	14·17
12	4 17	13·98	13 15	15·50	15 19	16·41	11 9	15·82	7 22	15·50	5 21	14·20
13	4 22	14·07	13 19	15·50	15 18	16·41	11 12	16·00	7 20	15·50	5 20	14·22
14	5 2	14·19	13 22	15·50	15 17	16·40	11 3	16·00	7 18	15·50	5 19	14·22
15	5 4	14·30	14 2	15·50	15 13	16·40	10 22	16·00	7 17	15·50	5 18	14·24
16	5 9	14·45	14 11	15·50	15 10	16·40	10 18	16·00	7 15	15·50	5 17	14·26
17	5 17	14·59	15 2	15·50	15 12	16·40	10 15	16·00	7 13	15·50	5 17	14·28
18	6 7	14·73	15 14	15·50	15 15	16·37	10 12	16·00	7 11	15·50	5 16	14·27
19	6 12	14·92	15 19	15·59	15 16	16·35	10 10	16·00	7 8	15·00	5 15	14·26
20	6 17	15·12	16 0	15·60	15 13	16·32	10 5	16·00	7 6	15·00	5 14	14·24
21	6 19	15·35	16 0	15·76	15 11	16·35	10 1	16·00	7 5	15·00	5 13	14·23
22	6 22	15·50	15 23	15·94	15 9	16·41	9 23	16·00	7 5	15·00	5 13	14·22
23	7 3	15·50	15 22	16·07	15 5	16·36	9 19	16·00	7 2	15·00	5 12	14·20
24	7 6	15·50	15 21	16·16	15 1	16·47	9 16	16·00	6 23	14·90	5 11	14·19
25	7 14	15·50	15 16	16·17	14 92	16·50	9 13	16·00	6 22	14·70	5 10	14·19
26	8 0	15·50	15 12	16·22	14 17	16·45	9 10	16 00	6 20	14·50	5 9	14·17
27	8 6	15·50	15 10	16·25	14 12	16·44	9 8	16·00	6 18	14·34	5 7	14·17
28	8 8	15·50	15 8	16·25	14 5	16·43	9 7	15·76	6 16	14·25	5 5	14·15
29	8 9	15·50	15 6	16·24	13 23	16·30	9 6	15·61	6 14	14·20	5 3	14·14
30	8 11	15·50	15 4	16·23	13 19	16·34	9 6	15·50	6 12	14·18	5 2	14·13
31	8 14	15·50	15 7	16·21	—	—	9 0	15·50	—	—	5 1	14·12

P.K. = pics, kirats. U.S. = upstream R.L.

REPORT ON THE NILE RESERVOIR WORKS,

1901

BY

A. L. WEBB,

DIRECTOR GENERAL OF RESERVOIRS.

REPORT ON THE NILE RESERVOIR WORKS, 1901.

1.—The Nile Reservoir Works consist of the following:—

(*a*) A Dam and Navigation Locks and Channel at Aswan
(*b*) A Barrage and Lock at Asyut
(*c*) A Regulator and Lock at the head of the Ibrahimiyah Canal at Asyut.

In former reports a detailed history of the project and a full description of the works executed in the different years have been given, but it is necessary to give a brief summary here, so that it may be intelligible to those who may not have seen the reports of previous years.

The Aswan Dam.

History of the Project.

2.—The preliminary studies and the preparation of the various projects for a Reservoir were made by Mr. W. Willcocks, C.M.G., Director General of Reservoirs, during the four years 1890-93.

The several projects were submitted to Sir William Garstin, K.C.M.G., Under-Secretary of State, who while giving his opinion in favour of the Aswan site, proposed that the whole question should be referred to an International Commission consisting of Sir Benjamin Baker, K.C.M.G., Signor Giacomo Torricelli, and M. Auguste Boulé.

As a result of the investigations of this Commission it was decided to construct a dam, to hold up water to R.L. 114, across the head of the Aswan Cataract, to the north of the island of Philæ, this being considered the only site that appeared to offer the necessary conditions of solid rock foundations, width of waterway, facility of construction, and sufficient storage capacity.

Finally, so as not to submerge the temples on the island of Philæ, a revised project was prepared by Mr. Willcocks for a dam to hold up water to R.L. 106, adopting the modifications proposed by Sir Benjamin Baker and Signor Torricelli.

It is this project which is now being executed.

On the 21st February, 1898, a contract was signed by H.E. Hussein Fakhry Pasha, Minister of Public Works, and Messrs. John Aird & Co., by which the latter undertook to construct the Aswan Dam, and Asyut Barrage and all connected works for the sum of £2,000,000, payment being made by sixty half-yearly instalments of £78,613, commencing on the 1st July, 1903, the date fixed for the completion of the works.

As the works have progressed more rapidly than was originally anticipated owing to the very low levels in the river, the monthly certificates have been met by payments partly in "Mandats" and partly in cash, advanced by the Finance Ministry. Moreover, during the progress of the works large excesses have occurred in the excavation of the foundations, owing to the bad rock met with, which has necessitated similar excesses in the masonry; these excesses, together with auxiliary works, will probably cause a final expenditure on all the works of £3,340,000, the excess of £1,340,000 being paid in cash advanced by the Finance Department and refunded by the Caisse de la Dette in two equal yearly payments of £670,000.

As erroneous statements have, from time to time, appeared, it may be as well to state clearly how the payments for the works are made. The contractors are paid each month the amount of the Engineers' certificate either in cash or its equivalent; moreover, monthly advances have been made on plant, materials, and preliminary works which are now being rapidly recovered as permanent work is being completed.

The late Mr. W. J. Wilson was appointed Director General of Reservoirs in 1898, and continued to hold that post till his death in August, 1900, when he was succeeded by the writer of this report.

Description of the Dam.

3.—The dam is to hold up water to R.L. 106, giving a maximum head of 20 metres, and a storage capacity of 1,065,000,000 cubic metres. The reservoir will be filled between December and March after the flood has passed, and will be discharged during May, June and July to supplement the summer supply in Middle and Lower Egypt.

The dam is 2,000 metres long, and straight from end to end. It is pierced by 140 lower sluices of 14 square metres area each, and forty upper sluices of 7 square metres area each. Its width at top (R.L. 109) is 7 metres, and at its deepest part 25 metres; the height from the deepest part of the foundation to the top is 40 metres. The interior masonry is rubble granite in 4 to 1 cement mortar, the exterior casing being large squared rock face granite in 2 to 1 cement mortar. The lining of 30 lower sluices is of cast-iron; the whole of the remaining lower and upper sluices are lined with heavy granite ashlar. The regulation of the sluices is made by means of steel gates, the greater number of which work on free rollers suspended in frames on the system designed by the late Mr. F. G. Stoney, and manufactured by Messrs. Ransomes and Rapier.

On the left flank of the dam there is a navigation channel 2,000 metres long provided with four locks, each 70 metres long and 9·50 metres wide. The gates slide into recesses in the sides of the lock walls: two gates are 19 metres high, one 15 metres, one 12 metres, and one 11 metres.

The foundations of the dam and locks are on solid granite: wherever rotten rock has been found, excavation has been carried down until solid rock has been met with.

Work during the year 1898.

4—.Preliminary works were commenced in April, and arrangements made for the necessary plant and material. The actual permanent work done was 21,399 cubic metres of excavation on the east end of the dam and in the navigation channel.

Work during the year 1899

5.—Excavation was completed for a length of 740 metres and in progress over a further length of a 600 metres: the total quantity of excavation done during the year was 100,212 cubic metres.

The foundation stone of the dam was laid on 12th February, 1899, by H.R.H. The Duke of Connaught. The total quantity of masonry laid during the year was 74,703 cubic metres.

Very considerable work was carried out in closing the channels known as the Bab el Kebir, Bab el Haroun, and Bab el Soghaiyar, by means of stone "sadds," in anticipation of the following season's operations.

Work during the year 1900.

6.—Taking advantage of the exceptionally low levels of the river, enormous progress was made both on the line of the dam and in the navigation channel and locks, so that by the end of the season's work the foundations of the dam were built in all the channels of the river with the exception of the large western channel; out of a total length of 2,000 metres the foundation masonry was laid for 1,825 metres.

During the year 208,851 cubic metres of excavation, and 164,605 cubic metres of masonry were executed.

The excavation of the navigation channel was well advanced, and masonry commenced on the locks in June.

Work during the year 1901.

7.—At the end of 1900 the only foundation work remaining to be done was that in the large channel at the extreme west of the dam, known as the Western Channel.

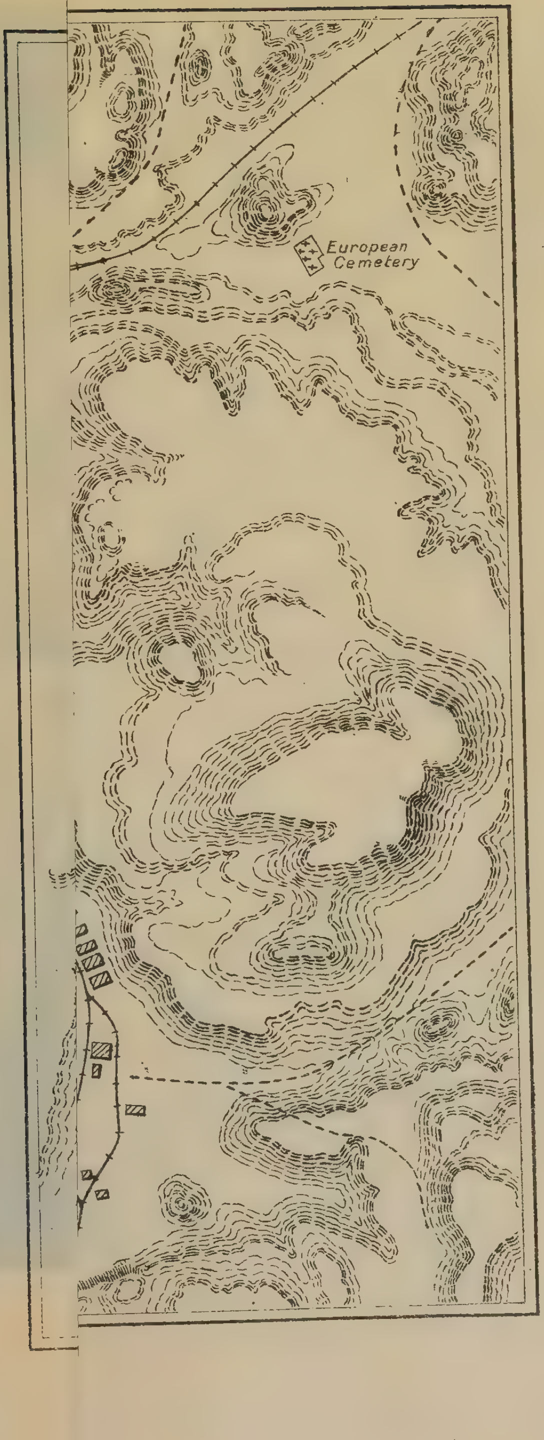
Operations for drying the channel were commenced on 5th November, 1900, by starting a stone "sadd" across the Mohammed Ali Channel in order to check the rush of water coming from the eastern channel: this "sadd" was closed on 21st November, 1900, and was then staunched on the upstream side with sand. On 6th December, 1900, a start was made to "sadd" the Western Channel at the southern end of El Hesa Island, and the Dechania Channel between El Hesa and Awad Islands, the former with sand-bags, and the latter with stone. Whilst these "sadds" were under construction, a commencement was made on two "sadds," composed of sand and small stone, to enclose the site of the foundations of the dam; by the first week of February, 1901, all the "sadds" were completed and pumping commenced to unwater the bed of the western channel. Four 12-inch centrifugal pumps were employed in pumping out the area between the "sadds," but after strengthening the latter and staunching them with sand, one pump was sufficient for dealing with the leakage. On February 21st the bed of the channel was pumped dry and excavation commenced.

As in the other deep channels on the line of the dam, the rock was found to be considerably decomposed, and excavation was carried down to an average depth of 6 metres before solid rock was reached; in the centre of the channel the excavation was carried down to R.L. 75 for a length of about 80 metres.

On April 17th masonry was begun, and by May 18th the bottom was completely covered. Work was continued until 17th July, when the masonry reached a level of R.L. 96·00 and the sadds were cut.

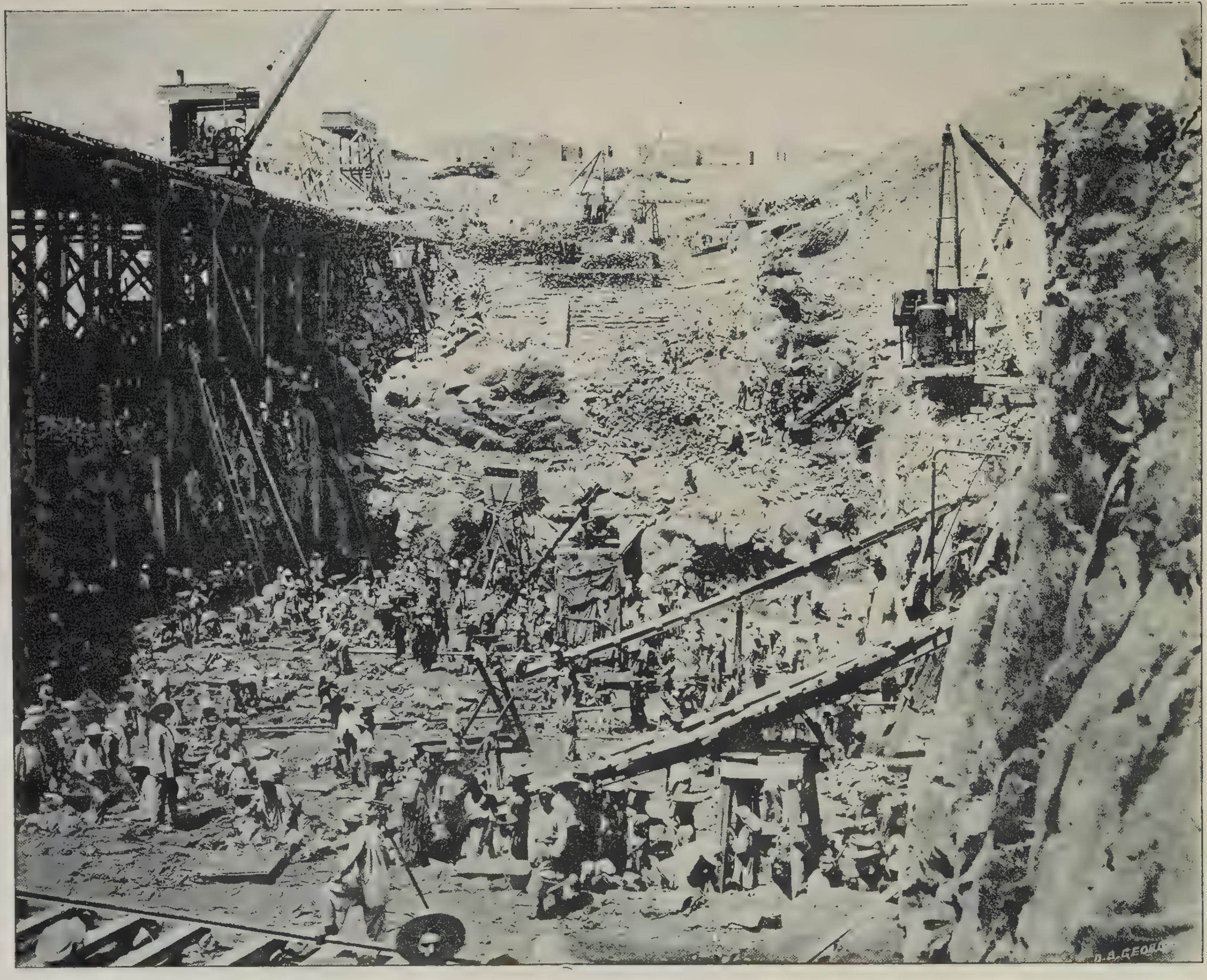
On April 11th a sadd was commenced across half of the central channel in order to proceed with the masonry which had been built up to R.L. 91·00 during the previous season: masonry was started on

PLATE VIII.



Surv

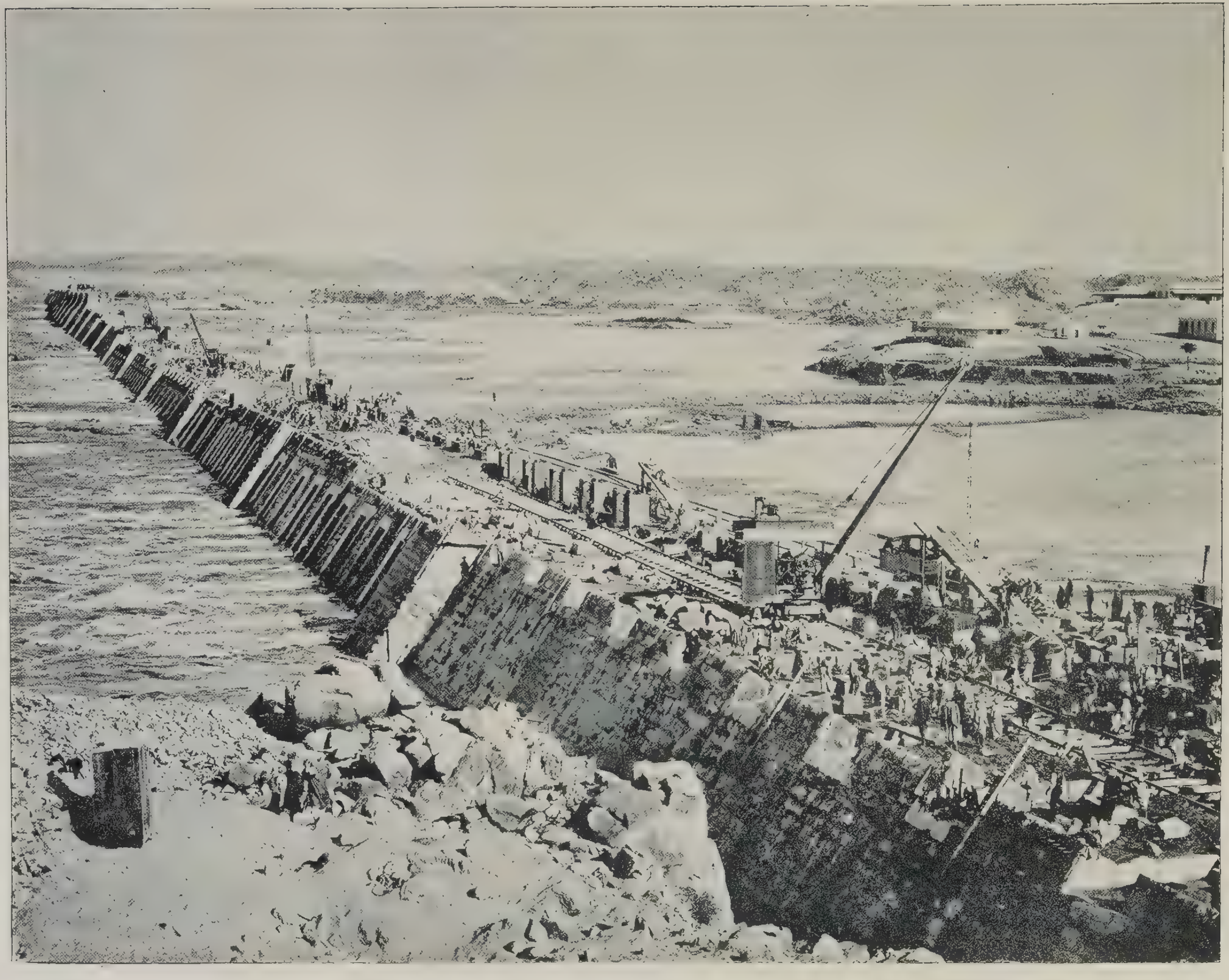
PLATE VI.



SUR. DEPT. P.W.M.

ASWAN DAM: WEST CHANNEL.

PLATE VII.



SUR. DEPT. P.W.M.

ASWAN DAM: FROM WEST BANK.

May 7th and carried up to R. L. 96·00, when work was stopped for the season.

On the rest of the line of the dam the masonry was vigorously pushed on, and everywhere brought above flood level before the end of the season, so that the only portion of the work submerged during the flood was in the central and western channels, where the masonry was purposely kept at R. L. 96·00 to afford an escape in case of an exceptionally high flood, and thus prevent inundation of the buildings and railways required for the following season's work.

During August and September a commencement was made on fixing the parapet and coping at the eastern end of the dam, which was continued as the masonry advanced.

During October masonry was started on the whole of the lower portion of the dam, and by the end of the year had reached an average level of R. L. 99·00.

In the navigation locks the masonry was proceeded with, and before the flood the whole of the foundations were built and the side walls so far advanced that work could be continued during the flood, and at the close of the year only about 6,000 cubic metres of masonry remained to be done.

In order to improve the river for navigation purposes a channel 20 metres wide was cut through the narrow rapids north and south of the dam. The latter was excavated without fresh "sadds" being made beyond those necessary for the foundations of the dam, but for the former two "sadds" were necessary. On the southern rapid 5,600 cubic metres of rock were excavated, and on the northern 20,000 cubic metres: the whole was completed before the flood.

Subsequent examination has shown that at the northern rapid the velocity is still so great that navigation will be difficult at all times and, during certain periods of the year, almost impossible unless auxiliary assistance is given by means of tugs or winding engines fixed on the bank. The only solution, though expensive, seems to be the construction of a lock, which will then render navigation absolutely safe and easy. This lock should be constructed during the early months of 1903.

In order to give a free waterway to the sluices, a trench 5·00 metres wide was excavated along the dam on the upstream face wherever the rock was found to be higher than the cills of the sluices, and on the downstream face excavation was carried out wherever it was necessary to direct the discharge from the sluices into the natural channels of the river. The total amount of excavation executed was 60,000 cubic metres.

8.—The quantities of permanent work executed to the end of the year on the dam and locks combined were as follows:—

WORK.	Quantity executed		TOTAL.
	to end of 1900	during 1901.	
	C.M.	C.M.	C.M.
Excavation...	577,515	112,355	690,370
Masonry	239,468	236,344	475,812

Taking the dam and navigation locks together, only about 65,000 cubic metres of masonry remained at the end of the year to be done to complete the whole of the work.

Under the very able direction of Mr. Blue, the Resident Agent of Messrs. John Aird & Co., the masonry is so advanced that it may be confidently stated that the whole will be completed by the end of May, 1902.

9.—The sub-contractors for the ironwork, Messrs. Ransomes and Rapier, made considerable progress with their work during the year. The whole of the sluices lined with cast-iron were erected; the cast-iron grooves and cills of one hundred sluices were fixed, leaving eighty still to be finished.

A commencement was made in the autumn to fix the sluice gates and thirty were placed in position by the end of the year.

In the navigation channel the erection of the two 19-metre lock gates was commenced and rapidly proceeded with.

Such rapid progress has since been made with the erection of the ironwork, under the able superintendence of Mr. H. E. Tabor, the Resident Engineer of Messrs. Ransomes and Rapier, that it is confidently expected the whole will be in working order before September next.

10.—The value of Permanent Work executed is shown below:—

To end of 1900.	During 1901.	Total to end of 1901.
£	£	£
597,339	1,224,278	1,821,817

11.—In accordance with the terms of the contract, advances were made to the contractors and sub-contractors of the ironwork, on Preliminary Works, Materials and Plant, amounting to £290,555: these advances are recovered as permanent work is completed. A payment of £29,800 has also been made in connection with land and houses required for the work.

The total payments made to the contractors to the end of the year is as follows:—

	£	
Aswan Dam	1,412,025	
Aswan Navigation Channel	289,872	
Subsidiary Works	11,126	
Import Duties	46,355	
Ironwork	62,239	
Total Permanent Work	1,821,617	
Less retention	33,000	
Advances on Preliminary Works	26,212	
„ Plant	18,826	
„ Materials	75,928	
„ Ironwork	169,559	290,555
Land		29,800
Total payment		£2,108,972

Workmen.

12.—The average number of men employed during the year was 5,347, of whom 756 were Europeans. The maximum number employed during any one month was in June, when 8,552 Natives and 902 Europeans were working.

Diagrams and Photographs.

13.—The following Diagrams accompany this Report, viz.:—

A.—General Plan of Reservoir Works.

B.—Longitudinal Section of Dam showing yearly progress of Masonry.

C.—Two photographs of works in progress.

Inundation of Villages and Lands in the Reservoir Valley.

14.—In December arrangements were made to demarcate the levels of the water which would be reached with a full reservoir in the villages and lands south of the dam. Messrs. Brown and Binnie were deputed to carry out this work, and considerable progress was made before the end of the year, so that the Mudiriyah authorities could ascertain exactly the houses and lands which would be inundated and arrange for the necessary valuation.

Discharges of the River.

15.—In order to ascertain the quantity of water entering the Reservoir, it is necessary to prepare discharge diagrams of the river corresponding to recorded gauges at Wadi Halfa and Aswan. Arrangements were consequently made to take discharges at both sites every fortnight, and a commencement was made in December by appointing Messrs Kennewell and Lazone for this purpose at Wadi Halfa and Aswan respectively.

Establishment.

16.—Mr. Maurice Fitzmaurice was Resident Engineer till December, when he left to take up his appointment as Chief Engineer of the London County Council. He had been in charge of the Aswan Reservoir Works since their commencement, and had rendered most valuable service to the Egyptian Government by his exceptional ability, energy, and tact, which were recognised by H.H. the Khedive, who at the time of his visit to the works in December, personally conferred on him the decoration of the 2nd Class of the Medjidieh Order. The Chief Assistants were Messrs. C. R. May and M. Macdonald, the former of whom succeeded Mr. Fitzmaurice as Resident Engineer. In addition to the above, twelve other engineers and inspectors were employed on behalf of the Government.

Mr. John Blue was throughout the General Manager of the Contractors, Messrs. John Aird & Co. His staff consisted of Mr. W. Bakewell as Chief Engineer, assisted by Mr. McCorquodale and several assistant engineers and inspectors.

Messrs. Ransomes and Rapier were represented by Mr. E. H. Tabor, assisted by Mr. Perry.

The result of the year's work is an eloquent testimony of the ability and energy with which one and all have worked: only those acquainted with the conditions prevailing at Aswan, especially during the intense heat of the summer months, can fully appreciate the excellent services rendered by the members of the Staffs of both the Government and the Contractors, and it can be confidently stated that both have always endeavoured to meet the wishes of Government in every possible may.

The Philæ Temples.

17.—The construction of the Aswan Dam has always raised the vexed question of the inundation of the Philæ Temples, about which so much has been written that it is quite unnecessary to repeat it here. Even with a dam to hold up water to R.L. 106, most of the temples and buildings on the Philaæ Island, with the exception of the great temple of Isis, will be covered with from two to four metres of water when the reservoir is full. In order to ascertain what measures could be taken to ensure the stability of the temples, it was decided to carry out exploratory work, and prepare designs and estimates of the cost of executing them.

The services of Dr. Ball were lent for this purpose by the Geological Department, and Mr. Mat Talbot was specially engaged by Sir Benjamin Baker, as an expert, for the sinking of the necessary shafts and all underground work. The whole work was under the general direction of Mr. Fitzmaurice, Resident Engineer of the Aswan Dam.

Exploratory Work—April to June.

18.—Though the Temple of Isis was known to be founded on rock and the great pylons on massive foundations extending in Nile silt down to R.L. 101·5, very little information existed concerning the rock depths and foundations at the numerous other buildings on the island. In the spring of 1901, it was therefore decided to commence a thorough exploration of the nature of the foundations and a special grant of £E.1,000 was given by the Public Works Ministry for executing the necessary works, which were commenced in April, 1901.

Fifty-six shafts, besides a number of headings and trenches, were excavated at the various points where useful information seemed likely to be obtainable, and all exposures of foundations and rock-levels were carefully recorded.

As so little was known at the outset concerning the stability of the structures, this work had to be conducted with the utmost caution, all openings being very strongly timbered, and the superstructures being supported by shoring, wherever there seemed to be the slightest risk of movement. In all, 690 cubic metres of excavation were done: the shafts were usually 1·30 by 1·00 metre in size, descending in some cases 13 metres before reaching the bed-rock. The whole was accomplished without mishap, not the slightest movement of any superstructure being detected. By the end of June sufficient information had been obtained to form a fair basis for an estimate of what underpinning works were necessary to ensure the stability of the structure: the excavations were then untimbered and filled in.

The chief deductions from the exploratory work were the following:—

(1) *The East Colonnade* rests on a nearly continuous masonry foundation about 2½ metres wide, descending on an average to R.L. 100·60, while the wall behind it, carrying the east ends of the lintels, is shallower, reaching an average of only R.L. 101·60. The colonnade and wall are nowhere on the rock, the level of which varies from R.L. 91·50 at the north to R.L. 98·00 at the south end. The intervening ground, between the base of the foundation and the rock is here, as in all the other cases examined, Nile deposit, muddy above and passing gradually into nearly clear fine sand as one descends.

(2) *The West Colonnade* is of a totally different type of construction from the east. Counterforts 1·80 metres thick run out eastward from the quay-wall at intervals of about 3 metres, descending in all cases to a great depth, if not actually to rock. On these counterforts the colonnade is carried by stone beams, which in most cases have fractured under the combined influence of the heavy load above, and the subsidence of the ground between the counterforts.

(3) *The Temple of Nectanebo* is founded on ancient walls which descend to rock: but the superstructure is placed askew to these walls in such a manner that portions are carried only by stone beams, which, like those in the West Colonnade, are mostly broken.

(4) The foundations of the *Temple of Ar-hes-Nefar* descend to R.L. 103·30, rock being found at R.L. 99·00.

(5) The foundations of the "*Kiosk*" descend to R.L. 100·60, and have a general breadth of about 4 metres. The rock-level at the river face of the building is below R.L. 90·00, and does not rise above R.L. 95·10 anywhere under the foundations. Under this temple are some old foundation-walls, probably representing an abandoned site: they do not add materially to the resistance to settlement.

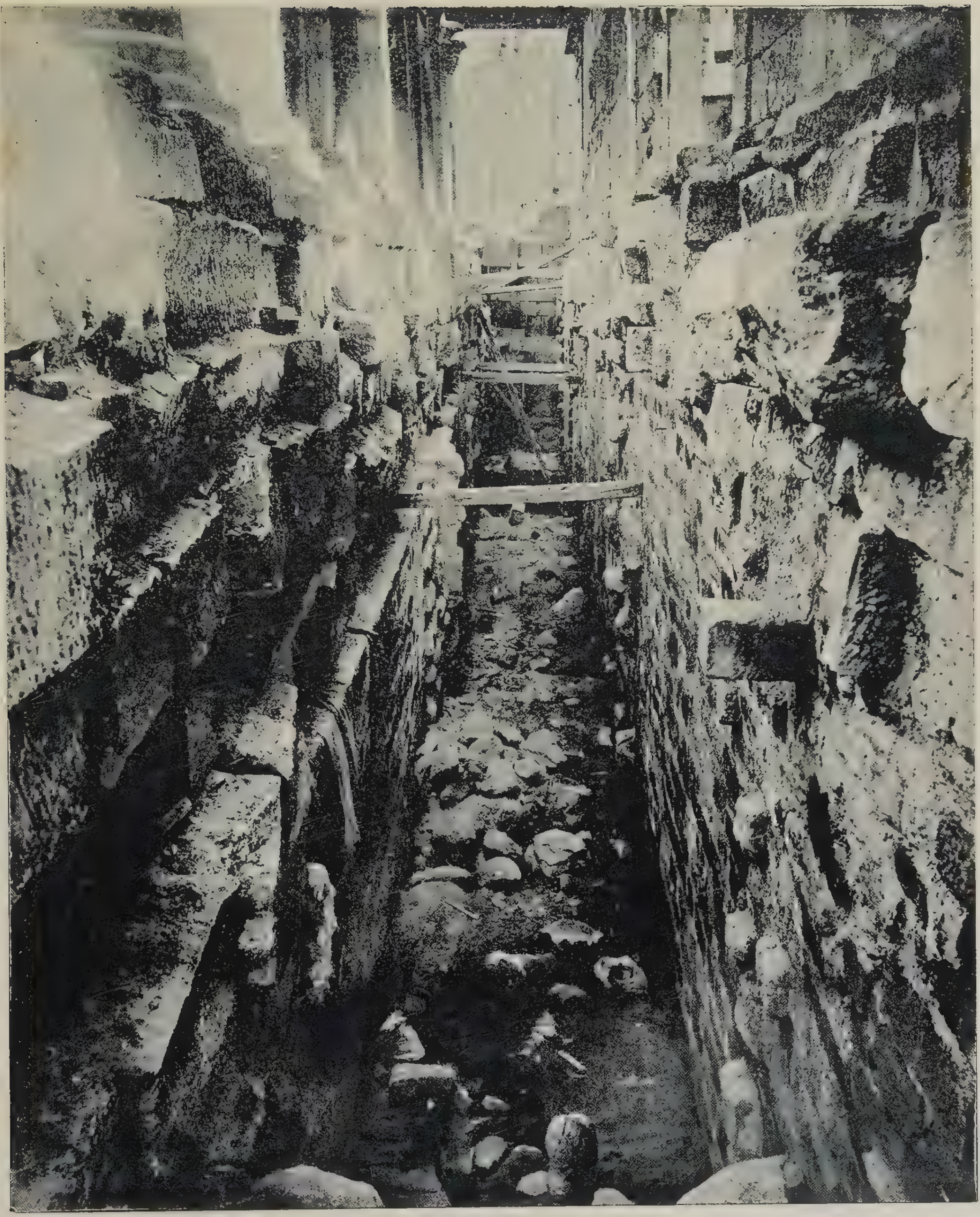
(6) *The Temple of Hathor* has footings descending to R.L. 103·40, rock being at R.L. 95·70 on the east side.

(7) *The Colonnade and Rooms on the east side of the Isis Forecourt* are founded on a broad continuous pavement of large stones, one course thick, at R.L. 103·30, the rock-level being generally R.L. 96·00.

(8) *The Mammiseum* walls descend to an average of R.L. 101·50, rock being struck at R.L. 93·60 at the south end, rising gradually northwards.

(9) A small portion of the Coptic village having been cleared as an experiment, is was found that sufficient sandstone of good quality, mostly in roughly squared blocks, could be thence obtained for the underpinning works likely to be undertaken.

PLATE X.



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PHILÆ.

Underpinning Works, begun in November.

19.—From the measurements and records made in the spring, a complete set of drawings of the different structures was prepared and submitted to Sir Benjamin Baker for an opinion as to what should be done. In accordance with his views an estimate was made, and it was decided to carry out the following works, for which a sum of £E.22,000 was granted by the Caisse de la Dette Publique.

(1) To underpin the *East Colonnade* and its wall with rubble masonry down to present saturation level (R.L. 97·00).

(2) To underpin the *West Colonnade and the Temple of Nectanebo* with rolled steel girders 14″ × 6″ × 54 lb. per lineal foot, surrounded by rubble masonry, well grouted, to resist access of water to the steel. The girders to rests in seats cut in the existing counterforts, and to be placed in pairs below the fractured stone beams.

(3) To underpin the "*Kiosk*" to R.L. 97·00 with rubble masonry 4 metres wide.

(4) To underpin the *Mammiseum* with rubble masonry down to R.L. 97·00

(5) Besides the above, to carry out such subsidiary underpinning or others works as should be found desirable, or necessary adjuncts to the main scheme.

It has since been decided to carry out the following:—

(*a*) To underpin the *East Colonnade and Rooms of the Isis Forecourt* down to R.L. 97·00.

(*b*) To underpin the *Temple of Hathor* to R.L. 97·00.

(*c*) To strengthen by underpinning the foundations of the gateway of Hadrian.

(*d*) To strengthen by underpinning the foundations of the gateway of Adelphos.

(*e*) To clear the whole of the Coptic Village.

(*f*) To carry out works of drainage and revetment of terraces.

The principle underlying the scheme adopted is, that the earth and sand below present saturation level will not subside further, and, provided it is prevented from rising (as is the case due to the weight of the ground above it) all buildings whose foundations are carried in sufficient breadth down to this level are secure against subsidence.

Typical sections of the walls of some of the buildings, showing the underpinning, are shown on Diagrams D and E, and in photographs Nos. 6 and 7.

Early in November Dr. Ball, who had been joined by Mr. Mat Talbot and his two sons from England, and Mr. Roberts, Masonry Inspector from the Aswan Dam, commenced operations, and by the end of the year the West Colonnade was completed, and considerable progress was made on the East Colonnade and the "Kiosk." In the West Colonnade the openings were made along the east face, i.e., outside the colonnade proper, in widths corresponding to the intervals between the counterforts. In the other buildings the underpinning is done in lengths of 1·50 to 2 metres, and is carried on at a number of points simultaneously. In the East Colonnade the shafts are sunk between the columns and the wall behind them, headings being driven both ways from the central shafts. In the Kiosk the whole of the openings are from the inside of the building. The Mammiseum, on the other hand, will be opened entirely from the outside, so as to avoid having to break its floor.

The Coptic Village ruins, which consist chiefly of unsightly mud-brick dwellings, are being gradually removed, while the worked stone they contain furnishes, after washing, excellent material for the new masonry. The two Coptic churches, and a few of the better houses, will be left untouched; all stones having hieroglyphic or other inscriptions, when found during the excavation, are carefully placed on one side for the Antiquities Department.

The estimate of £E.22,000 includes an item of £E.3,000, which will be transferred to the Antiquities Department for repairs to the superstructure of the buildings.

The amount expended on the works to the end of the year was £E.3,494; it is expected that the whole of the works will be completed by the end of June, well within the estimated expenditure.

The number of men employed averages about 330, of whom 300 are native excavators and laboureurs, twenty-six Italian timbermen and masons, and four English Inspectors. The energies of the last-named have been severely taxed owing to the necessity of very careful supervision in view of the special and somewhat dangerous nature of the work. Exceptionally useful assistance has been rendered by Mr. Mat Talbot, who has had long experience of works of a similar nature, and it is largely due to his sound judgment in matters of timbering that the works have been carried out without a single accident or movement of the buildings.

Mr. Fitzmaurice, as Resident Engineer of the Aswan Reservoir, controlled the operations of the exploratory work, the preparation of the estimates, and the commencement of the work of underpinning with his usual energy and ability. To Dr. Ball is due great credit for the excellent records and drawings made of the works, and for the supervision and payment of the workmen employed; throughout the operations his services have been greatly appreciated, and are certainly worthy of recognition.

Three photographs showing the works in progress are attached to this report.

ASYUT BARRAGE AND LOCK.

Object and Description.

20.—The reason for the necessity of constructing a Barrage across the Nile at Asyut is to augment the supply of the Ibrahimiyah Canal, which takes out from the river immediately south of the Barrage. By means of the augmented supply the existing perennial area of Middle Egypt and the Fayoum will enjoy improved irrigation during the summer, and about 400,000 feddans of basin land will be converted to perennial irrigation.

The Barrage consists of an open weir of 111 bays, each 5 metres wide: abutment piers 4 metres thick occur at every ninth opening, the intermediate piers being 2 metres thick; the piers are spanned by arches carrying a roadway 4·50 metres wide, as well as the travelling winches and suspension apparatus for the regulating gates, which are each 2·50 metres high, and when in position are capable of holding up from 2·50 to 3 metres of water during the summer months. The length of the Barrage is 833 metres, and the height from the floor surface to the roadway is 12 50 metres.

On the western flank there is a lock 80 metres long and 16 metres wide, capable of passing the largest Nile steamers.

Design and Construction.

21.—The foundation consists of a combined masonry and concrete floor, 3 metres thick and 26·50 metres wide, extending from bank to bank and laid thoroughout at the same level between two lines of cast-iron sheet piles, which descend 4 metres below the bottom of the concrete foundation.

The whole of the foundation is built of Isawiyah stone laid in cement mortar, and the superstructure of the same stone in homra and lime mortar.

On the upstream side there is an apron of puddle protected by pitching, and on the downstream an "inverted" filter bed and talus of pitching.

Work done during season 1899.

22.—The work was confined entirely to the western side, where the foundations of the lock and twenty-nine regulating openings were completed, and the lock walls and piers built above the summer level of the river.

The quantities executed were as follows:—

Cast-iron piles	693	lineal metres.
Concrete and masonry in floor	28,929	cubic metres.
Masonry above floor level	8,307	„
Pitching and clay puddle	30,147	„

Work done during season 1900.

23.—Advantage was taken of the very low levels of the river to push on the works as rapidly as possible, and an attempt to complete the whole of the foundations was almost successful. The piles on the up and downstream sides of the floor were driven right across the river, but, owing to an accidental breach in the sadds, caused by the rising flood on July 23rd, a length of 20 metres of the floor remained wholly unbuilt, and a further length of 140 metres only partially built.

The lock, with the exception of fixing the gates and the swing bridge, was practically completed. Twenty-seven piers were carried up to full height, forty-three others three-quarters full height and nineteen others above summer level, leaving nineteen still unbuilt.

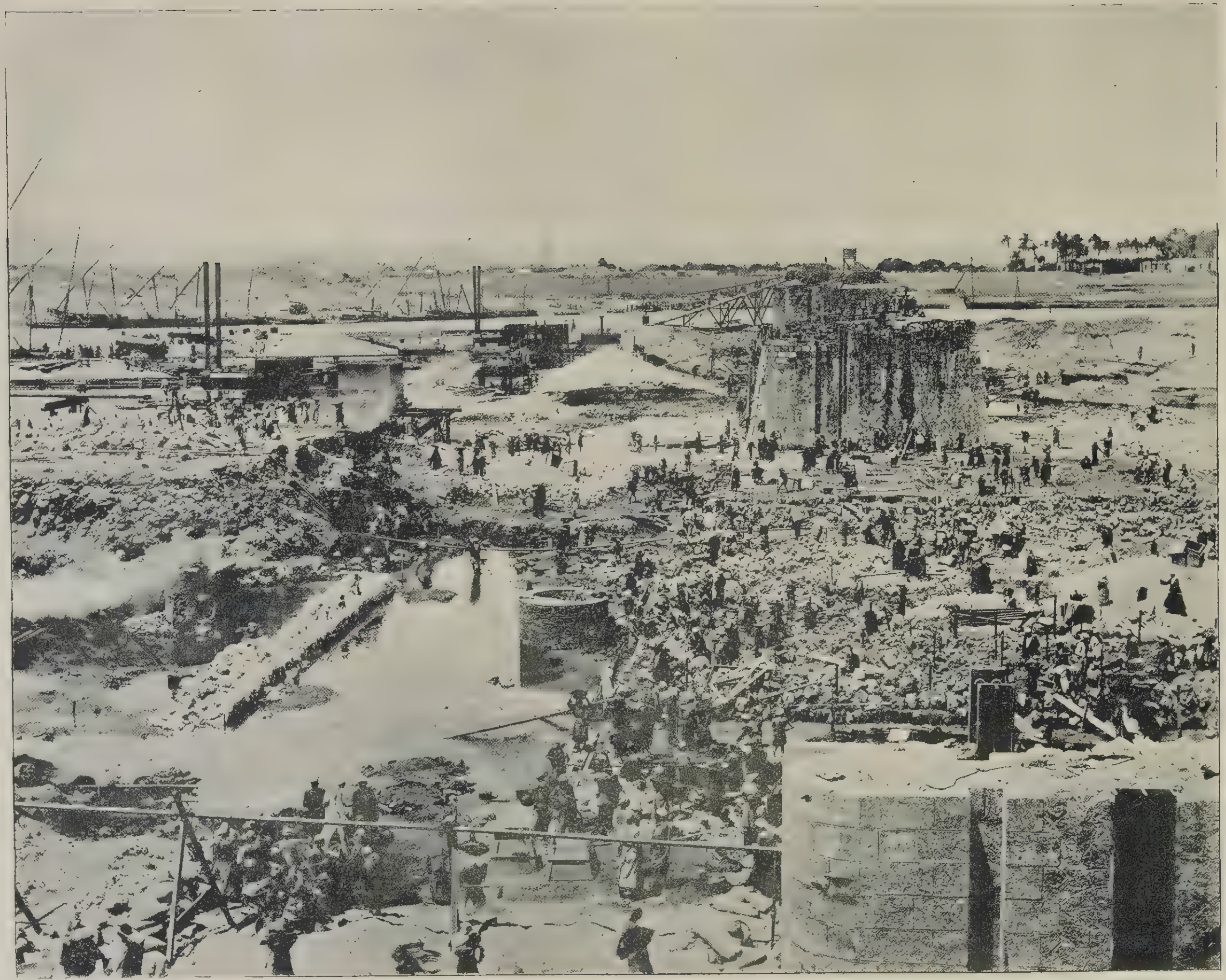
The quantities of work executed were:—

Cast-iron piles	1,241	lineal metres.
Concrete and masonry in floor	46,126	cubic metres.
Masonry above floor level	26,320	„
Pitching and clay puddle	52,183	„

Work done during season 1901.

24.—*Foundations.*—The foundation work remaining to be done was situated between the middle of the river and the east bank, and though of only short length, yet, from its position in the main stream of the river, it was the most difficult portion of the whole work, necessitating expensive preliminary works out of all proportion to the quantity of work to be executed. The construction of the necessary sadds for

Plate XIII.



SUR. DEPT. P.W.M.

Assiut Barrage: Works in progress.

near thescar-ends of the foundations previously built, great difficulty was experienced in laying the last piece of the foundation. Special measures were, however, adopted; and to insure that no voids existed under the new length of the floor, a large portion of it, even where no springs of importance were encountered, was drilled with holes for grouting, from 3 to 4 metres apart, and cement-grout forced down, whenever possible, through pipes standing up 5 metres above floor-level.

Prior to the laying of the last piece of foundation a long length of the floor previously built on the east side was found to have been undermined from springs, necessitating the grouting up of the same before much excavation work could be done, and this caused some delay in finishing the foundations.

During the season 284 springs were encountered, making a total of 974 dealt with since the commencement of the work.

The grouting was supervised most carefully by Mr. Hood, Chief Assistant Engineer, who has submitted a very interesting report on the operations of 1901.

Superstructure.—On January 12th the masonry was started on forty of the exposed piers partly built in the previous year. The designs having been approved for the arches, parapets, and all superstructure work above the piers, a start was also made with this work, and three arches built during the month of February.

By the end of the year nearly the whole of the superstructure was completed, with the exception of a portion of the parapet, and work was in such an advanced state thas is was confidently expected to lower the sluices into position not later than the first week of February, and thus keep sufficient water over the raised cill of the lock to enable navigation to continue without hindrance of any kind.

The gates of the Barrage Lock were fixed before the flood, and the lock was then practically completed, with the exception of the swing bridge, which had not been delivered by the end of the year.

IBRAHIMIYAH CANAL REGULATOR AND LOCK.

Object and Description.

25.—In order to control the supply entering the Ibrahimiyah Canal, especially in years of high flood, and to insure the safety of its works in case of an accident, a masonry Regulator and Lock have been constructed at its head, immediately south of the Asyut Barrage.

The work consists of a Regulator of nine openings each 5 metres wide, and a lock 8·50 metres wide. The regulation will be made by means of two gates, one upper and one lower, each 3·50 metres high.

Design and Construction.

26.—The design of the foundations is practically the same as that of the Barrage, and the whole is constructed in Isawyiah stone, the superstructure being almost identical with that of the Barrage.

Work during 1901.

27.—On 27th November, 1900, the temporary diversion for maintaining the supply of the canal was commenced, and on 13th February 1901, completed; sadds were then made across the existing channel up and downstream of the site of the regulator, and the whole supply passed through the temporary diversion; these sadds were completed on February 27th and the pumping and excavation for the foundations immediately commenced. Eight 12″ and one 8″ pump were employed in unwatering the foundations, which were of the same nature of those of the Barrage, and full of springs, of which 116 were dealt with.

Before the flood the work had been so vigorously carried on, that the temporary diversion could be sadded off, and the flood supply of the canal passed through the regulator and lock. By the end of the year nearly the whole of the masonry had been completed both on the regulator and the lock, but the ironwork had not arrived.

River-training.

28.—For some years the main channel of the river had been on the east bank, while a large shoal had been yearly increasing on the western bank, through which a narrow channel was maintained, principally by dredging, in order to supply the Ibrahimiyah Canal.

This condition of the river was undoubtedly favourable for the construction of the Barrage, especially in the two first seasons, but after the completion of the floor and piers, it was very unfavourable, as it was absolutely necessary to bring the main channel across to the west bank in order to allow navigation through the locks. With this purpose in view, and in the absence of regulating gates in the Barrage till the following January, it was decided to protect the upstream temporary sadds, made from the east bank to the middle of the river for enclosing the foundation site, with rubble stone, so as to form an obstruction on the east side during the flood and force the main channel over to the opposite side. The result has more than justified the most sanguine expectations. With the assistance of dredgers on the fall of the flood in November and December, the main channel of the river has been brought to the west bank, and there has been absolutely no hindrance to navigation throughout the winter.

That such a radical transformation should have been effected at a very small cost is certainly most satisfactory, and the engineers may well feel gratified at such a successful result of their operations.

In order to keep the main channel on the west bank, the sluice gates on the east side should be the last to be raised before the next flood, and the first to be lowered after the flood.

Quantities of work executed.

29.—The chief items of work done during the season on the Barrage Regulator, and other works, up to the end of July were as follows:—

Sadds	158,400	cubic metres.
Sand-bags in sadds	857,500	No.
Excavation and filling	483,628	cubic metres.
Dredging...	70,000	,, ,,
Pumping	Twenty-three 12-inch, one 10-inch, two 8-inch, and one 6-inch pump were constantly at work.	
Cast-iron piles	655	lineal metres.
Concrete and masonry in floor	19,449	cubic metres.
Masonry above floor level ...	24,961	,, ,,
Pitching and clay puddle ...	33,963	,, ,,

Diagrams and Photographs.

30.— The following Diagrams accompany this Report, viz.:—

F.—Progress Plan and Section showing work done during 1899, 1900 and 1901.

G.—Showing Section and Elevation of the Ibrahimiyah Canal Regulator and Lock.

Also the following Photograph, viz.:—

(8) Asyut Barrage—completing the foundations.

Establishment.

31.—Mr. G. H. Stephens was the Resident Engineer throughout the year, and left the service of the Government in April, 1902, when the works had practically been completed. He had been in charge of the works from their commencement to completion, and had rendered valuable service to the Egyptian Government, by the ability and energy with which he surmounted the difficulties encountered, and successfully completed the works almost two seasons before the contract period. In recognition of his services H.H. the Khedive conferred on him the decoration of the 2nd Class Medjidieh.

The Chief Assistant was Mr. E. Hood; in addition there were three other assistants and four inspectors.

Mr. H. H. McClure was the Agent of Messrs. Aird & Co. throughout the year. The thanks of Government are due to him for the manner in which he has pushed on the works: in every possible manner he has endeavoured to meet the wishes of Government, and it is largely due to his tact and patience and power of organizing labour and materials, that the works have been so speedily and successfully terminated.

General.

32.—Sir Benjamin Baker, K.C.M.G., Consulting Engineer to the Egyptian Government, inspected the Reservoir Works at Aswan and Asyut during the year. He was accompanied by Sir John Aird Bart. and Mr. John Aird.

Expenditure on Reservoirs Works.

33.—The attached Appendix gives a statement showing the expenditure on the Reservoir Works in the years 1898, 1899, 1900 and 1901, as well as the total to the end of the year.

A. L. WEBB.

APPENDIX.

STATEMENT SHOWING THE EXPENDITURE ON RESERVOIR WORKS TO END OF 1901.

	EXPENDITURE IN				
	1898	1899	1900	1901	TOTAL.
	£	£	£	£	£
Permanent Work, Aswan Dam	20,886	273,075	567,015	840,921	1,701,897
Retention under Clause 39 of Specification ...	3,132	29,264	604	—	33,000
Payment on account of Permanent Work. ...	17,754	243,811	566,411	840,921	1,668,897
Advanced on Preliminary Works, Aswan Dam.	20,729	72,746	71,029	**−138,292*	26,212
Advanced on Plant	31,040	33,545	**−8,915*	**−56,844*	18,826
„ Materials	25,376	142,813	45,685	**−137,916*	75,958
„ to Messrs. Ransomes and Rapier...	—	55,972	69,133	106,693	231,798
Total payment on account of Aswan Dam. ...	94,899	568,887	743,343	614,562	2,021,691
Advanced on account of Asyut Weir and Lock...	46,024	274,917	240,765	232,740	794,446
„ „ payment for Land. ...	23,400	12,100	500	500	40,500
„ „ Import Duties	8,100	18,900	13,000	9,000	49,000
Subsidiary Works	3,934	8,731	*−1,315*	1,526	12,876
Total... ... ... £	176,357	883,535	1,000,293	858,328	2,918,513

* Advances recovered as permanent work progressed.

REPORT ON THE TANZIM DEPARTMENT

1901

BY

A. H. PERRY.

REPORT ON THE TANZIM DEPARTMENT, 1901.

Cairo, April 15th, 1902.

To the Under Secretary of State,
Public Works Department.

Sir,

I have the honour to submit a Report on the operations of the Tanzim Department for 1901.

The following Services are treated separately:—

Chief Inspection, Lower Egypt;
„ „ Upper Egypt;
Inspection Tanzim North;
„ Repairs East;
„ „ West;
Drawing Office;
Tramways, Electric Lighting and Telephones;
Helwan Water Service;
Ghizeh and Ghezireh Service;
Bridges;
Ezbekiyeh Gardens;
Scavenging and Watering Service;
Local Commission Water-works;
Cairo Roads, Tanzim and Gas Service;
Rain-water drains;

A statement showing the total value of public buildings constructed since 1895 is attached.

The following officers have done especially good work;—

Mr. Sayed Bey Choucri.
„ Clifton.
„ Hewat.
„ Chapman.
„ Pastour.
„ Reboul.

Mr. Ehrlich.
„ Curtis.
„ de Cosson.
„ Powell.
„ Fitz Patrick.
„ Habib Effendi.

I have the honour to be,
Sir,
Your obedient servant,

A. H. PERRY,
Director General of Towns and State Buildings.

CHIEF INSPECTION SPECIAL WORKS, LOWER EGYPT.

Mr. Clifton.

NOTES ON LIST *A*.

Works taken over finally in 1901.

As the list shows, ten works, representing a total expenditure of £E.139,859, exclusive of drawing office expenses, were taken over in 1901, after the usual year's guarantee.

With the exception of the Mansour Prison, where a serious failure of the column base stones took place (see Appendix I), the repairs required have not been important.

At the Port-Said Gouvernorat the plastering of parts of the cornices became detached, and had to be repaired at the contractor's expense.

The Tor Quarantine Station has stood well, in spite of its exposed position. Beyond making good small delapidations to doors, windows, locks, and plastering, nothing was required at the final reception. The hydraulic lime plastering has stood exceedingly well, and there can be no doubt that this is the best kind of plaster for withstanding the effects of sea air, whether it be at Tor, Alexandria or Port-Said.

At the final reception of the Cairo Native Court of Appeal, many of the doors and windows were found to be warped and twisted. This was owing to their having being left shut, but not properly bolted; and this neglect on the part of those in charge of the building resulted in considerable expense for repairs which might have been avoided by the most ordinary attention.

At the Shebin-el-Kom hospital, the roof, which is of kosromel, had to be entirely relaid at the contractor's expense.

For the remaining buildings no repairs of any importance were necessary.

Column K shows that £E.23,522 were spent on contingent, or 20·92% on the original contract price of £E.112,447 (column H.)

Column L gives cost of overseers, which is 3·45% on (H) contract price or 2·85% on (M) total cost.

NOTES ON LIST *B.*

WORKS COMPLETED DURING 1901 OR STILL IN COURSE OF CONSTRUCTION.

Expenditure in 1901=£E.91,505.

A.—General.

(*1*) *Egyptian Museum.*

The interior of this building is now practically complete, and the keys have been handed over to the Museum authorities.

The work done during the year has consisted chiefly in completing the plastering and in laying the cement and mosaic floors. Twelve fire hydrants have been fixed in different parts of the building, in accordance with the requirements of the police. A one-ton lift has been erected for conveying objects to the first floor; and a system of lightning conductors, connecting all the iron skylights, has been fixed at a cost of £E.200.

The pixoline roof covering continues to be satisfactory, but will have to be carefully examined from time to time, as the system is new in this country.

There has been considerable delay in the settlement of the south boundary between the Public Works Departments and the Army of Occupation. The question, however, is now settled, and the railings, which now enclose the Gizeh Museum, will shortly be removed and erected along the south boundary. These, as well as the other boundary walls, will, it is hoped, be up before the end of April.

The space available for exhibition purposes in the building is 15,000 square metres as compared with 9,700 square metres in the Gizeh Museum.

(*2*) *Arab Museum.*

This building, for which Mr. Tréhaki is the contractor, should have been finished by the end of November. The delay has been caused to a great extent by the sub-contractors for the floors and lintels, which are constructed in "Beton Armé," système Hennebique. The Museum will probably be ready by the end of April.

The masonry and "monier concrete" roof were finished in August, and since then the work done has chiefly consisted in plastering and fixing skylights, doors and windows. The decorative plastering, both inside and out, is well forward. Three fire hydrants have been fixed on each floor, as well as a stand-post at the entrance door.

(3) *Geological Museum.*

The contract date for the completion of this work, which was begun in April, 1900, was the 22nd of January, but owing to certain modifications in the design and the difficulty of laying the irregular encaustic tile, the building was not taken over till May. A fine of £E.30 was imposed on the contractors.

(4) *The Lady Cromer Memorial.*

This building was begun by Mr. Tréhaki in May, 1900, and completed last April at a cost of £E.2,500 or 25% less than the original estimate.

Mr. Trehaki, the contractor, generously undertook this work at prices which allowed him no profit, as a contribution towards the fund.

(5) *Tanta Tanzim Office.*

This building is being carried out by Margossoff Bey.

The progress of the work has been seriously hindered owing to the difficulty of getting materials delivered by the Railway Administration, whose scanty supply of trucks is continually causing delay.

The masonry is almost finished and the building should be ready by April.

(6) *Boulac Stables.*

This work, consisting of seven sets of stables, is being constructed for the Scavenging and Watering Service to replace those existing at Kasr el Nil, which are to be handed over to the Army of Occupation.

As the boundary wall of the Museum cannot be completed until this exchange is made, the work at Boulac is being pushed on as fast as possible and should be finished in March.

The contract was signed on the 5th of September, but some delay was caused before work could be begun, owing to a claim of "Ancient Lights" which had to be allowed, and which made it necessary to modify the project. There was also considerable difficulty in getting in the foundations owing to the proximity of existing buildings.

The foundations for the stables are in monier concrete (Hennebique system). The masonry is now nearly finished and plastering will shortly be begun.

(7) *Residence for Direction General, Museum.*

This building is being constructed in the north-east corner of the new Museum grounds.

It should be finished by the end of March, when the Museum authorities are to move to Kasr el Nil.

B.—**Customs.**

(1) *and* (3) *Sheds for Customs, Alexandria.*

These sheds, ten in number, are to be used for sheltering merchandise when landed on the quays. They have been urgently required for many years, as the customs may be held liable for goods damaged by rain.

The sheds, with the exception of one which has a tiled timber roof, are built entirely of iron on concrete foundations. In the case of two sheds, pile foundations were found necessary.

The total surface covered by the ten sheds is 9,166 square metres.

The great obstacle throughout has been want of space, the customs authorities not being prepared to hand over enough ground to enable work to be carried on simultaneously on all the sheds. The work has been considerably delayed, but is now nearing completion.

(2) *Addition to Tobacco Store, Alexandria.*

In this building, the roof, flooring, and the pillars which carry them, are all in monier concrete (Hennebique system). Masonry is only being employed in the panels between the pillars.

The work forms a very good illustration of the advantage of this form of construction. It was begun in September last, and will be finished before the end of March, that is in five months. This building costs £E.12,500 and covers an area of 4,000 square metres. If cast-iron columns and wrought-iron or steel joists had been used for the roof and floors it would have been necessary to order them from

Europe, which would have involved waiting at least six months before delivery, with a possibility of a further delay in case any of the iron-work had to be refused.

Monier concrete has, moreover, the more lasting advantage of being fire-proof, a quality of which the value cannot be overrated in a building which is to hold goods of a combustible nature.

C.—**Interior.**

(*1*) *Completion of Gouvernorat, Port-Said.*

The west wing of this building was finished early in 1900, and a centre and east wing are now being constructed.

The work, which was begun on the 31st of September, is progressing favourably, and is now well above ground-level.

Since the commencement of the work, the Governor of Port-Said and others have suggested that it would have been much better to place the building on the site of the old slaughterhouse which overlooks the harbour, and is perhaps more suited for an important government building of this type than the one chosen.

If the change were insisted on, the finished wing and the new foundations might be adapted for the use of the Native Summary Tribunal, Native Tribunal for religious cases, and the Tanzim Office.

The Gouvernorat is the only building which could be conveniently situated on the site of the old slaughterhouse, and could thus, if desired, represent Egypt in a monumental fashion at the Canal entrance.

(*2*) *Cairo Fire Station.*

This building is to contain five fire engines and twelve horses, and comprises barracks for firemen and police. It is to replace the existing fire station, which is in a dilapidated condition and altogether inadequate for the service.

The work has been delayed owing to the difficult nature of the foundations, which are honeycombed with old sewers. A start will soon be made with the concrete.

(*3*) *Nawa Markaz.*

This building was begun on the 20th of October; the foundations are nearly finished, and the elevation masonry will shortly be begun.

When concreting had begun, the Railway Administration objected to the work being continued on the ground that the site was within 20 metres of their line. They claim to have a control over the construction of buildings within these limits. They have, however, agreed to allow the work to continue.

D.—**Justice.**

(*1*) *Shebin el Kom Summary Law Court.*

This building was completed last July by Ali Badaoui, whose work throughout was very satisfactory.

This contractor is the only native who tenders for any of our works, and should be encouraged as far as possible.

It was found impossible to complete the garden of this building, owing to the excessive cost of making up the ground to the flood-level of the Bahr el Shebin. It would have been necessary to bring the filling from the Batanounia Canal, 5 or 6 kilometres distant.

(*2 and 3*) *Additional Work to Cairo Native Court of Appeal.*

Under this heading various details are included, such as partitions, blinds, alterations to doors, fire hydrants, and the furnishing with seats of six audience chambers. The latter are designed by Mr. Hewat.

The work is now completed and the Ministry of Justice have taken possession.

(*4*) *Building to contain the Archives of the Cairo Native Court of Appeal.*

This work was begun on the 18th of December by Messrs. Manusardi and Ambrosoli. The excavation is at present in progress and concrete will shortly be begun. The building is to be finished by the 15th of May.

(*5*) *Port-Said Summary Law Court.*

The contract for this work has been signed, and Messrs. Guétin and Charvaut, the contractors, will begin work at once.

The site is next to, and east of, the new Gouvernorat.

E.—**Posts.**

(*1*) *Additions to Cairo Post Office.*

The first half of this building was completed in March and the remainder in July, 1901.

The foundations in monier concrete (Coignet system) have proved, as far as can be seen at present, a complete success. Not a single crack has appeared in the building.

Six cast-iron columns, specially ordered in Europe, were found on arrival to be of such inferior quality that they had to be refused. They were, however, replaced by columns made in monier concrete, for which Messrs. Guétin and Charvaut are agents.

The delay which would have been caused by ordering new cast-iron columns was thus avoided.

(*2*) *Port-Said Post Office.*

This building, which was begun last September, has so far been progressing favorably, and is now at ground floor-level.

The stone used for this building, as well as for the new Gouvernorat, is from the Old Cairo quarries.

This is the first time that stone other than that from Cyprus or Ismailia has been used at Port-Said.

The foundation stone was laid by the Governor of the Suez Canal on January the 2nd.

F.—**Education.**

(*1*) *School of Law.*

This building is being constructed at the north-east corner of Abdin Square. It has accommodation for from 100 to 150 law students.

The contract was signed last July, but owing to the exceptionally bad foundations, which necessitated a change of design, the concrete has not been begun, but will be started in a few days.

(2) *Sanieh School.*

This building will contain accommodation for 300 girls. The foundation, like that at the Fire Station and Law School, has delayed the progress of the work, and nothing but excavation has so far been accomplished. There has also been some trouble with the owners of adjoining property over question of boundaries and "ancient lights." So far these have been settled satisfactorily.

G.—**Coastguards.**

(1) *New Roofs to Alexandria Stores.*

These roofs, wich were constructed by Messrs. Guétin and Charvaut in monier concrete (Coignet system), were completed last June. They were subjected to specially severe tests which they stood satisfactorily.

H.—**Sanitary.**

(1) *New Pavilion, Alexandria Hospital.*

This building was finished last April. The work, which was carried out by Mr. Tréhaki, was well and carefully done throughout. The foundation, however, was a bad one, consisting partly of solid, and partly of made ground, and there has been a settlement of the portion of the building which rests on the latter. This settlement is being attended to.

K.—**Prisons.**

(1), (2), (3) *and* (4) *Manshia, Tanta, Alexandria, Zagazig.*

These works have progressed as satisfactorily and smoothly as can be expected under the existing system of dual control.

At the Alexandria prison a question arose with regard to the strength and quality of the cement-mortar used for the floor arches. The sand used in this mortar was found by analysis to be calcareous, and therefore not the most suitable that could have been employed. It was therefore decided to test one of the floors, all of which had been completed before the question arose. The result of the test was that the floor carried 13½ tons per square metre or more than thirty-three times the required load, without any crack.

In the neighbourhood of Alexandria all the sand, whether in the desert or on the sea-shore, seems to be of the same description, namely carbonate of lime, mixed with fragments of shells and a variable proportion of quartz grains (averaging 15%); it is therefore not the best for building.

It would, however, be as little worth while bringing sand from a distance as it would to convey stone from Old Cairo for constructions in Alexandria.

In concluding this report, I wish to draw attention to the present unsatisfaciory system of control over buildings constructed for the Prisons Department. The designs are made by an architect in the employ of the Prisons Department, who is also responsible for seeing that they are carried out. At the same time the Special Buildings Department is responsible for the good materials and workmanship during execution.

The result of this arrangement is that the expense of surveillance is doubled, and there is necessarily a certain amount of friction between the supervising engineers.

I think that either the Public Works Department should be given entire charge both of designing and executing as is done with work for other departments, or the Prison Architect should carry out his own work after first submitting his drawing to the Public Works for verification and approval. The responsiblility of the latter department would then end, unless alterations were found necessary during construction, when the architect would submit these for approval.

The adoption of either of these arrangements would do away with the present system of dual control, which has from the beginning proved troublesome and expensive to both departments concerned.

The Sanitary and Quarantine Administrations have their own architects who design and carry out their own buildings without any reference to the Public Works Department.

This is certainly a better arrangement than the one existing with the Prisons, but at the same time it would perhaps be better if all projects for Government Works (that is Public Works) were submitted to the Public Works Department for approval. If after the approval, a department prefers to itself undertake the execution, I do not see any objection to their doing so, under the general inspection of the Public Works Department.

CHIEF INSPECTION SPECIAL BUILDINGS, LOWER EGYPT.

A.—Works taken over finally during 1901.

Order.	Administration	Date of provisional reception.	Name of Work.	Contract Price.	Final situation.	Overseers.	Total cost, i.e., K + L*	Sanction.	Percentage of over seers on total cost.	Contractors.	Date of final situation.	Remarks.
D	E	F	G	H	K	L	M		N	O	P	
				£E.	£E.	£E.	£E.	£E.	%			
A.	*Interior.*											
1		3–1–1900	Markaz Simbelawin	1,466	1,691	77	1,768	1,777	4·4	Aly Badawi.	19–2–1901	
2		13–1–1900	" Galioub	1,577	1,609	111	1,720	1,747	6·4	Badir Chenouda.	20–3–1901	
3		30–12–1899	" Toukh	1,714	1,705	143	1,848	1,927	7·7	Do.	6–6–1901	
4		9–5–1900	Governorat, Port-Saïd ..	4,385	4,546	231	4,777	5,000	4·8	Zouro & Patouna.	15–7–1901	West wing.
5		28–12–1900	Quarantine Station, Tor ..	33,800	40,941	598	41,539	41,580	1·4	Guétin & Charvaut.	15–2–1901	
B,	*Justice.*											
1		12–5–1900	Cairo Native Court of Appeal and Prison.	58,708	73,446	2,400	75,846	64,000	3·2	Centonze, Marciano & Parboni.	17–4–1901	For excess. see Appendix I.
C.	*Education.*											
1		4–1–1900	House for Director of Medical School	2,891	3,160	83	3,243	3,350	2·5	Pezzi & Goussard.	15–1–1901	
D.	*Sanitary.*											
1		11–11–1899	Port-Saïd Slaughterhouse..	2,034	2,490	184	2,674	2,687	6·8	Zouro & Patouna.	25–2–1901	
2		9–10–1899	Hospital, Chebin-el-Koom .	4,872	5,401	106	5,507	5,507	1·9	Vigano Vittorio.	16–3–1901	
3		27–11–1900	Old Cairo Disinfectiug Station	920	883	54	937	1,050	5·8	Hamilton & Grant.	7–12–1901	
			Totals.. .. £E.	112,347	135,872	3,987	139,859	128,625	2·85			

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* Exclusive of Architect's charges.

CHIEF INSPECTION SPECIAL BUILDINGS, LOWER EGYPT.

B.—WORKS COMPLETED DURING 1901, OR STILL IN COURSE OF CONSTRUCTION.

Order.	Administration.	Date of completion during 1901	NAME OF WORK.	Date of commencement.	Sanction.	IN COURSE OF CONSTRUCTION			CONTRACTORS.	REMARKS.
						Expenditure.		Probable date of completion.		
						Before 1901	During 1901			
L	M	N	O	P	Q	R	S	T	U	
					£E.	£E.	£E.			
A—1	*General.*	—	Egyptian Museum	2–1–1897	249,521	175,357	23,038	31–12–1901*	Garozzo & Zaffrani.	*Interior of building.
2		—	Arab Museum.	31–5–1899	50,000	34,429	12,589	30–3–1902	Marsili & Tréhaki.	
3		7–5–1901	Geological Museum	22–4–1900	4,500	2,694	1,466	See column N	N. Marciano.	
4		23–4–1901	Lady Cromer's Memorial	10–5–1900	3,670	868	1,788	See column N	A. Tréhaki.	
5		—	Tanta Tanzim Office	30–7–1901	2,000	—	600	31–1–1902	Margossoff Bey.	
5		—	Boulac Stables	5–8–1901	10,000	—	2,471	5–3–1902	Zaffrani, Annigoni & Gandolfi.	
7		—	Residence for Director Gl., Museum .	21–6–1901	4,400	—	956	31–3–1902	Garozzo & Zaffrani.	
B—1	*Customs.*	25–7–1901	Shed, Alexandria..	14–2–1901	4,000	—	3,289	See column N	Padova & Rolin.	
2		—	Addition to Tobacco Stores, Alexandria	21–3–1901	12,000	—	3,942	21–3–1902	Hennebique.	
3		—	Nine new sheds on Alexandria Quay .	29–6–1901	12,056	—	11,606	13–1–1902	Padova & Rolin.	
C—1	*Interior.*	—	Completion of Gouvernorat, Port-Said	31–8–1901	13,000	—	2,411	5–10–1902	Guétin & Charvaut.	
2		—	Cairo Central Fire Brigade and Station to Police Barracks..	7–10–1901	25,000	—	*1,096	1–12–1903	G. Garozzo.	*Foundations only,
3		—	Police Barracks, Nawa..	20–10–1901	2,800	—	15	17–5–1902	Aly Badawi.	
D—1	*Justice.*	5–7–1901	Shebin-el-Kom Summary Law Court.	29–8–1900	3,430	491	2,528	See column N	Do.	
2		6–9–1901	Improvements to Native Court of Appeal-Cairo	3–7–1901	1,250	—	1,263	See column N	N. Marciano.	
3		—	Native Court of Appeal-Cairo, Seating Audience Chambers..	1–12–1901	852	—	—	31–12–1901	Zaffrani, Annigoni & Gandolfi.	
4		—	Native Court of Appeal-Cairo, Archives	18–12–1901	2,000	—	—	15–5–1902	Manusardi & Ambrosoli.	
5		—	Port-Said Summary Law Court.. ..	25–12–1901	4,250	—	—	25–12–1902	Guétin & Charvaut.	
E—1	*Posts.*	13–7–1901	Addition to Cairo Post-Office	10–9–1900	12,100	4,034	8,263	See column N	Do.	
2		—	Port-Said Post-Office	11–8–1901	25,000	—	4,827	1–2–1903	Do.	
F—1	*Education.*	—	School of Law	21–7–1901	22,100	—	1,560	1–4–1903	Makar & Pilogatti.	
2		—	Sanieh School.	1–9–1901	27,200	422	1,664	22–6–1903	Basile Antoniou.	
G—1	*Coastguards.*	21–6–1901	New Roofs to Alexandria Stores ..	9–11–1900	2,925	11	2,913	See column N	Guétin & Charvaut.	
H—1	*Sanitary.*	29–4–1901	New Pavilion, Alexandria Hospital..	25–8–1900	4,000	969	3,247	See column N	A. Tréhaki.	
K—1	*Prisons.*	—	Manshia..	—	—	—	—	—	N. Prosperi.	
2		—	Tanta	—	—	—	—	—	Ghezzo & Fedrigo.	
3		—	Alexandria	—	—	—	—	—	McClure & Dorling.	
4		—	Zagazig	—	—	—	—	—	Ghezzo & Fedrigo.	
			Total.. .. .. £E.		471,654	219,275	91,505			

APPENDIX I.

Report on Mansour Prison Repairs.

(By Mr. Clifton).

Introduction.

Without entering into the many reasons which necessitated the general arrangement of the building as carried out, I will limit myself to a description of the investigations of the causes for its partial failure and of the work carried out to remedy the defects. The building, situated in Cairo, is four stories high. The ground, first and second floors give accommodation to 250 prisoners and the third floor to 200 police.

The corridor wall of the police barracks is carried by two cast-iron columns one above the other, 10·85 metres (35′ 6″) high altogether.

This column transmits a load of 58 tons to the stone base of the columns.

The building is founded on a float of puzzoulana concrete 1·25 metres (4 feet) thick, laid at permanent infiltration level. This form of foundation was adopted as the excavation showed that the whole area of the foundation was at one time a deep depression which had been filled up many years ago with earth, stones, and rubbish. Infiltration water prevented the excavation being carried down to virgin soil.

As there are no cracks in the outer walls of the building, it may be assumed that this float of concrete is intact.

Signs of failure.

Soon after the completion of the building, cracks appeared in the brick cross-walls of the police barracks. Starting at floor level, where this wall rests on the corridor wall below, the cracks followed a line drawn from this point to the point where the ceiling meets the top story corridor wall which is carried on the columns.

Supposed causes of failure.

These cracks were evidently caused by the columns settling, and on investigation it was found that the base flanges of some of the columns were cracked. On stripping the asphalt off the stone bases these also were found to be cracked. These cracks could only be attributed to the crushing of the stone.

It appeared also that the base stone had carelessly been dressed to a concave surface, which would have the effect of throwing the pressure on the outside of the base flange and account for its being cracked. It was further observed that the stones were saturated with damp, which made them soft. This was the result of the water used for swabbing down the ground (prison) floor finding its way to the stone through the joint between the asphalt and the cast-iron columns.

By calculation it was found that the base stone of native limestone 0·80 metres × 0·80 metres × 0·45 metres (2′ 8″ × 2′ 8″ × 1′ 6″) was exposed to a pressure under the base plate of 42 kilogrammes per square centimetre. The ordinary samples of this stone crush at 211 kilogrammes per square centimetre (3,000 lb. per square inch); the safety factor was thus 5.

This explanation of the causes of failure was not very convincingly satisfactory. Should the stone have crushed when only loaded to $\frac{1}{5}$ of its laboratory crushing strength, even though it was weakened by being saturated with damp?

New stones 1·15 metres × 1·15 metres × 0·45 metres (3′ 6″ × 3′ 6″ × 1′ 6″) deep were ordered from Triest, new columns from England. Tripod shores on wide timber bases were erected round the columns. Gypsum tell-tales showed that the movement continued.

Much deliberation was given to settling on the best means of supporting the superstructure (a load of 58 tons) while the thirteen columns and base stones were changed. No risks could be run, as from 400 to 500 people inhabited the building. The result was so satisfactory that during the work no change was found necessary either in the shoring or the method of working.

General scheme of remedy.

The shoring showed in the accompanying drawing No. 2 consisted of a pair of A frames set up under the girder carrying the gallery at 1st floor level. Their feet were let into timber bed-plates 0·60 metres × 0·35 metres (2′ 4″ × 1′ 2″) with a tightening-up wedge under the foot. This wedge was specially useful in loosening the shoring before removing it. Under the bed-plate and directly below each foot were two pairs of iron folding wedges working between iron plates. The lower plates rested on a bed of cement concrete 3·60 metres × 3·60 metres × 1·00 metres (12′ × 12′ × 3′ 6″) thick.

This bed of concrete was necessary to distribute the pressure, all of which came on new filling 3 metres (10 feet thick), interposed between the lower original concrete foundation and the bottom of the new concrete. The pressure on the earth was thus reduced to less than $\frac{1}{2}$ kilogramme per square centimetre ($\frac{1}{2}$ ton per square foot).

The longitudinal rolled joist 35 centimetres deep (14 inches deep) at the 1st floor not being stiff enough to carry the weight between the A frames when the column was removed, iron joists which bore on the A frames, where packed in under the flanges of the saddle-piece between the upper and the lower column.

Also vertical shoring with tightening wedges was carried up to the main girder carrying the top story corridor wall. The upper columns were thus relieved of their weight during the operation.

All the shoring was braced across the building and tied to the main walls.

To avoid vibration as much as possible in tightening up the wedges when transferring the load to the shores, two 50-ton hydraulic jacks were set up between the A frames and the base stones. These took the first lift.

A piano wire was stretched between the main walls touching the columns to enable the vertical movements to be recorded.

Execution of Scheme.

On excavating to put in the cement concrete for the first column, the cracks in the base stone, which were little more than visible on the surface, were found to be wide enough at the bottom of the stone to allow of the insertion of the fingers of the hand up to the palm. Wrought-iron straps were quickly fixed round the stones to prevent them opening further, and shoring was put up under the longitudinal girder of the first floor at the edge of the pit.

A boxing of 3 centimetres ($1\frac{1}{2}$ inch) boards was made round the pit to prevent the earth filling from falling in while the concrete was being rammed.

The concrete was allowed seven days to set before the shores for changing the columns were erected.

When all was in place the wedges on the first and second floors were driven hard with a sledge hammer.

The jacks were then worked until a slight rise* of from 1 to 3 millimetres ($\frac{1}{32}''$ to $\frac{1}{8}''$) was observed on the wire. Thus all shoring except the legs of the A frames had its strain.

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* These figures and the following represent the maximum and minimum observations taken on the thirteen columns.

The iron folding wedges under the A frames were then driven hard.

Stone cutters with chisels then cut away an inch clearance under the column, which was thus left suspended by the bolts of its upper flange.

The jacks were next slacked when a drop of from $2\frac{1}{2}$ to $4\frac{1}{2}$ millimetres ($\frac{3}{32}''$ to $\frac{3}{16}''$) occurred.

After a short pause to let the shores settle down to the weight, the rest of the base stone was cleared.

Main Cause of Failure.

The main cause of the failure then became apparent. The stone in setting had been levelled up with wooden wedges, which were left in place, and grouted with pozzuolana mortar. The grouting in some cases had not even touched the underside of the stone at the middle, and in all cases the bed was found to be hollow at the centre so that the whole weight was supported on the wedges and an outer margin of about 15 centimetres (6 inches) wide, where the mortar could be rammed under with a trowel. Consequently the stone broke into four pieces at the lines of least resistance.

The old base stone having been extracted, the old column was slung, unbolted and removed. In order to give clearance for getting in the new stone and column the top course of the rubble masonry under the stone, about 15 centimetres deep (about 6 inches deep), was demolished.

The new Trieste stone base was then slung into place by means of a lewis and differential blocks, without being set, and was left some 15 centimetres (6 inches) below its ultimate level. The new column was then slung and bolted up permanently into its place. A wrought-iron plate $2\frac{1}{2}$ centimetres thick (1 inch thick), planed on its upper face, was laid between the stone and the base of the column.

The stone base was next raised on wooden wedges so as to leave only 1 to $1\frac{1}{2}$ centimetres ($\frac{3}{8}''$ to $1\frac{1}{2}''$) clear below the column. After being levelled, a grouting basin in brick masonry in cement was built round the stone at a little distance from it, the walls were 20 cubic metres (8 inches) higher than the bottom of the stone.

Neat cement grout was introduced under the centre of the stone by means of a 5-centmietre (2-inch) pipe. The grout was under a head of four or five feet (1·50 metres). In this manner the space under the centre of the stone ought to be as well filled as any part. See drawing No. 1.

By having a head on the grout a flow was established from the centre to the outside of the base, which carried with it the air and cement scum.

Thin steel wedges were used to force the wrought-iron plate against the base flange of the column and the 1-centimetre ($\frac{3}{8}''$) space under the plate was grouted with neat cement under some 10 centimetres ($4''$) head.

After setting seven days, the wedges under the stone, as well as the steel wedges, were withdrawn, and the shoring removed. On removing the shoring the drop varied from 0 to $\frac{3}{32}''$ (0 to $2\frac{1}{2}$ millimetres). The greatest collective drop on any column, adding all the movements together, was under 6 millimetres ($\frac{1}{4}''$), the mean drop of the thirteen columns was 4 millimetres ($\frac{5}{32}''$) and the least $2\frac{1}{2}$ millimetres ($\frac{3}{32}''$).

This satisfactory result was due to the great assistance received from Mr. R. Holt, of the Educational Department, for the calculations, and from Mr. H. Curtis, of Guizeh, for the excellent workmanship displayed in the shoring and to the well-drilled gang of men he had trained, with whom he carried out all the operations but the masonry work.

TANZIM DEPARTMENT.

Summary Report on Beton Armé executed in 1901.

The following is a list of the buildings in which Beton Armé has been used:—

(1) New Post Office, Cairo—Foundations.
(2) Geological Museum, Cairo—Floors and roof.
(3) Arab Museum, Cairo—Floors and roof.
(4) New Tanzim Stables, Boulac—Foundations, also roofs for several out-houses.
(5) Coastguard stores, Alexandria—Roof.
(6) Addition to Tobacco Store, Alexandria—Foundations, pillars, floors and roof.
(7) Fever Hospital, Alexandria—Wall-plates.

Of these, 1, 5 and 7 were carried out by M.M. Guetin and Charvaut in their "System Coignet," for the remainder, system Hennebique was used.

The foundations of the Cairo Post Office and the double roof of the Alexandria Tobacco Store are of special interest, as each represents a class of work new to this country.

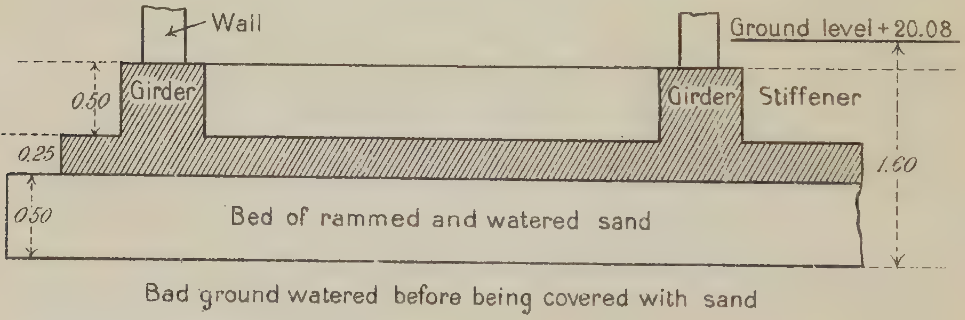
NOTES ON LIST.

(1) *Foundations of Cairo new Post Office.*

On sinking trial holes on the site of this building the ground was found to be quite unsuitable for supporting the weight of a structure on any ordinary foundations, as there were noumerous old walls as much as 7 metres below ground level, with soft refilling between them.

The contractors, Messrs. Guetin and Charvaut, were therefore asked to prepare a project for the execution of the foundations in Béton Armé. Their design, which, I understand, is entirely original, consists of a table 24 centimetres thick, covering the whole of the ground surface with girders 50 centimetres deep under the walls, and stiffeners running at right angles to the girders (see sketch), the whole being so arranged as to give a maximum pressure of 300 grammes on the square centimetre of ground surface. The girders are made strong enough to resist the transverse stress which would be caused supposing the ground below were to completely collapse for a length of 3·50 metres. They are also capable of acting as continuous girders in case of several collapses taking place at intervals. The calculations for the stiffeners are likewise based on the assumption of the most unfavourable conditions likely to occur.

The sketch shows the general arrangement of the foundation.


Wall
Ground level + 20.08
0.50
Girder
Girder
Stiffener
0.25
1.60
0.50
Bed of rammed and watered sand
Bad ground watered before being covered with sand

The result of adopting this system was an economy of £E.689 on the original estimate, and its success is proved by the fact that even where the new masonry is joined to the old there has, up to the present time, been not the least sign of a crack. I am therefore inclined to recommend similar foundations for the new Fire Station and the Law School, at both of which the ground is as bad, if not worse, than at the Post Office.

(2) *Floors and Roof of the Geological Museum.*

The only point worthy of notice about these floors is that they were continued through the walls so as to form, not only a thoroughly good chainage for the latter, but a rigidly fixed and substantial "lid," greatly increasing the solidity of the building as a whole.

The tests made on these floors gave most satisfactory results.

(3) *Arab Museum.*

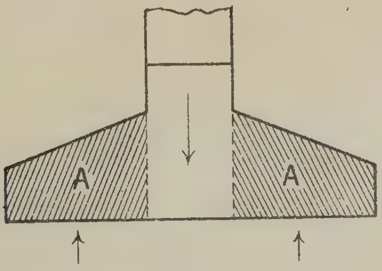
The floors of this building were constructed in the same way as those of the Geological Museum.

The idea of continuing the Béton Armé floor through the thickness of the walls, which originated with Mr. Pastour, is now being universally adopted by Mr. Hennebique.

(4) *Boulac Stables.*

The foundations of this building consist of Béton Armé footings of such a width as to reduce the pressure on the ground surface to ½ a kilogramme per square centimetre.

By using this class of foundation it is possible to reduce the pressure on the ground surface to a minimum, in a very small depth, as the projecting cantilevers A A′ (see sketch) can be made practically as strong as is desired, so that the risk of their breaking off is removed and an even pressure on the ground ensured. The saving in excavation is therefore considerable.



(5) *Roof of Alexandria Coastguard Stores.*

This roof was constructed by Messrs. Guétin and Charvaut in their "Coignet" system; the results of the tests were satisfactory.

Unfortunately, owing to bad workmanship in erecting the centring, several of the girders have the appearance of having sagged. Further, the use of sand alone instead of gravel as the metal for the "System Coignet" resulted, in these roofs, in numerous cracks, which though really quite harmless, combine with the appearance of sagging referred to, in giving the whole roof an unsafe appearance. In order, therefore, to prove that the danger was imaginary, the most unsafe looking girders were tested to four times their specified load, with the result that there was a maximum sag of 2 millimetres over a span of 7 metres.

(6) *Addition to Alexandria Tobacco Store.*

The only point of interest in this work is the introduction of a double Béton Armé roof, the object of which is to keep the building cool. On the advice of the Director General, the space between the upper and lower roofs is unventilated, and the air inside it therefore remains at a more even temperature than would be the case if communication had been left with the outside atmosphere.

The use of Béton Armé in this building has resulted in a considerable saving, the total cost being £E.9,980 or £E.588 less than the lowest tender for the construction with iron roofs and floors as specified.

(7) *Alexandria Fever Hospital.*

The Architect who designed this building specified two Béton Armé wall-plates, one at ground level, the other immediately below the roof joists. The arrangement is an excellent one, but unfortunately the ground under the building, which is very bad, settled, and caused a crack which passed through the wall-plates, the latter not being calculated for so great a strain.

In future it would be as well to make these wall-plates strong enough to carry at last three metres of their load when unsupported from below, to allow for settlements like the one referred to.

In conclusion, all the work done in the various systems of Béton Armé in this country has been of a satisfactory nature, and its safeness, neatness, cheapness, as well as its fire-proof qualities and the time saved by using it, are all in favour of its wider use in the future.

Mr. Pastour, though unable to attend the Paris Commission on experiments in Béton Armé, visited several buildings in Paris where the work was in progress, and is of opinion after what he saw that the quality of the work in this country compares very favourably with that of the French contractors.

CHIEF INSPECTION SPECIAL WORKS, UPPER EGYPT.

MAINTENANCE OF GOVERNMENT BUILDINGS IN UPPER EGYPT DURING THE YEAR 1901.

Out of about 160 buildings in the eight provinces of Upper Egypt fifty-four have been repaired at a cost of £E,1,970.136 mill. (see Table A). Only the most urgent were taken in hand. Out of the £E.5,000 granted £E.2,874 was taken to pay for work done in 1900, leaving only £E.2,126 available for 1901.

The contractors for general repairs for the Provinces of Girgah, Kena and Aswan are Messrs. Zaffrani, Annigoni and Gondolfi. Mr. Fumaroli is the contractor for the Provinces of Beni Suef, Fayum, Minia and Assiut; Gizeh is worked from the Inspection Central Office in Cairo, and Messrs. Manusardi and Ambrosoli are the contractors.

They have all done their work well. It is extremely difficult to carry out these repairs without considerable delay, as the contractors naturally wish to complete the repairs in one town before removing their men to another which may be some distance away.

It is also no light task for three contractors to spread their men over a reach of 700 miles in such a manner as to expeditiously execute small repairs.

A sum of £E.262 was placed at the disposal of the Ministry of the Interior so as to allow of rough repairs being done by village labour in the Mudiriahs of Gizeh, Fayum, Beni Suef, Minia, Assiut, Girgah and Kenah. The result has not been a success. In many of the new buildings erected since 1895 very inferior work has been done, marring their aspect. Whitewash has been splashed over windows, doors and ceilings.

The Inspectors of the Interior might have an average of £E.20 to spend on each of the twenty-seven buildings or a total sum of £E.540. The Inspection South will control the repairs of twenty-one buildings at an average of £E.50 for each. This equals £E.1,050. An arrangement of this sort will relieve the Tanzim circles of much unimportant work.

As there are only five new and five old schools, the repairs of all will depend upon the Inspection South.

Out of eleven Mahkemes only three are old; all repairs will therefore be done by the Inspection South.

All Finance buildings and moudiriahs will be attended to by the same Inspection.

ZOOLOGICAL GARDENS, GIZEH.

The two lion houses were commenced and completed this year. There are seven interior cages, two exterior cages, visitors' hall and store in each block. Mr. Fumaroli was the contractor.

The Director's house was considerably enlarged and many improvements introduced—a new office, lavatory and store, and a new kitchen were added to the building and the house repaired throughout. This was done by Messrs. Manusardi & Ambrosoli, the general contractors for repairs.

The contract drawings for a house to contain delicate animals have been prepared by Mr. Hewat and will be let to contract at an early date.

Additions to a small extent were made to the elephant house.

KENA WATER SUPPLY.

When the masonry of the pumping station and town reservoir had been about half finished under the direction of the Mudir, the whole of the completion works were placed in our hands.

Alterations and additions, which almost amounted to reconstruction, had to be undertaken, as the building and foundations for the pump and engine had been so badly executed. The whole of the work had to be completed before the Nile began to rise.

The first contractor was paid off, and Messrs. Zaffrani, Annigoni & Gondolfi were entrusted with the completion of the works.

New drawings had to be made and the works were pushed on rapidly. The pumps began to work and the town of Kena was supplied with water on the 12th September. Up to the end of the year every thing worked well. Slight repairs had to be made to the suction pipe. As the suction pipe from the river to the pump could not, owing to running sand, be placed low enough to sink the foot-valve below the lowest river level, a portable or petroleum engine and a centrifugal pump will be employed for a few months annually to raise water to the well at the river from which the main pump draws.

600 balasses and 80 girbahs are filled at the taps daily and the earnings amount to about 60 P.T. per day. The charge made for water is 20 hordas or ½ a mill. per girbah, and 10 hordas or ¼ of a mill. per ballass. The demand for water for drinking purposes will probably increase largely.

To fill the tank the pump works for about one hour per day, but when a heavy call is made for watering streets and gardens it may work 2½ hours per day.

Telephone connection should be made between the pump and town reservoir. The existing primitive arrangement is for the ticket collector to watch the gauge in town, and to send a man to the pumping station to inform the engineer there to pump 60, 70 or 80 minutes, as necessity demands.

Pipes should be laid into the town to increase the facilities for the street watering service.

TABLE A.

LIST OF REPAIRS ORDERED AND EXECUTED DURING 1901.

TOWN.	DESCRIPTION OF WORK.	Estimated cost.		Actual cost.	
		£E.	Mill.	£E.	Mill.
Biba	Stopping half window in Prison of Merkez	1	—	1	—
Kena	Repair of shed roof in school	4	—	1	900
Fayum	Repair of stairs in Mudiria	12	—	12	—
Assiut	Making two skylights and two windows in Mahkama Sharia	25	—	21	498
Giza	Mazyara for the Merkez	14	820	14	820
Ayat	" "	13	820	13	820
Sennures	Repair of purup in Abattoir	1	584	1	584
Manfalut	Repairs made in the Merkez	33	—	29	795
Magaga	Repairs of terrasse in Post-Office	25	—	20	954
Edfu	Gravel supplied to the court of school	10	—	10	—
Edfu	Price and erection of purup in school	26	—	25	410
Sohag	Benches supplied to Sohag Tribunal	118	—	118	—
Giza	Repairs in Irrigation store in Merkez	35	—	35	—
Cairo	Fixing type manger in Veterinary Stable	1	210	1	210
Magaga	Well sank in the Merkez	35	—	27	598
	Price of one type manger (wooden pattern)	5	—	5	—
Sohag	Pipes for Sohag School	28	900	28	900
Kena	General repairs in Kena School	120	—	138	450
Kena	Inspection house, Kena	250	—	292	136
Deshna	General repairs in Government buildings	30	—	30	—
Girga	Repairs of asphalte briquettes in Merkez	15	—	3	199
Nag-Hamadi	" "	15	—	4	079
Sohag	Repairs in W.C. of Mudiria	180	—	195	—
Esna	Repairs in terrasse of tribunal	90	—	89	216
Deshna	" "	90	—	85	917
Assiut	Mazyara for Mudiria	6	—	7	218
Sohag	Asphalt flooring in magazines of Merkez	13	—	11	302
Embaba	New pump in the Markaz	10	—	2	—
Abnub	Repair of veranda floor, Merkez	10	—	10	—
Kena	Repairs in Sanitary Office	40	—	54	543
Kena	Repairs in the Merkez	23	—	29	111
Giza	Price of timber used for repair of pillars, Museum	5	272	5	272
Assiut	Repairs in terrasse of Mudiria	40	—	75	—
Girga	Repairs of well, Merkez	20	—	9	053
Minia	Repair of boundary wall, tribunal	5	—	4	256
Minia	Shesha ventilators for tribunal	18	—	18	—
Fayum	Cloison in Mudir's Office	10	—	11	094
Minia	Repairs in boundary wall of Tanzim Office	10	—	9	838
Giza	Repair in boundary wall of Agricultural School	18	130	18	130
Beni-Suef	Reservoir and pump for water supply	300	—	211	098
Fayum	Furnishing the Tanzim Office	50	—	53	—
Sohag	" "	50	—	54	—
Sohag and Fayum	Other requisites for Tanzim Offices	60	—	58	259
Fayum	Paid to 4th Circle of Irrigation for store	80	—	80	—
Kena	Opening a window in Mudir's Office	10	437	10	437
Wasta	Asphalte briquettes in stable of Merkez	32	039	32	039
	£E.	1,990	712	1,970	136

TABLE A′.

BUILDINGS COMPLETED IN UPPER EGYPT IN 1901 WITH THEIR SANCTIONED AMOUNTS AND ACTUAL COST.

Chief Inspector's Office, Upper Egypt.

Number.	TOWN.	BUILDINGS.	Sanctioned Amounts.	Actual Cost.	Economies.	Excess.	REMARKS.
			£E.	£E.	£E.	£E.	
1	Minia	Hospital	5,550.000	5,195.889	354.111	—	
2	Sennures	Merkez and Police Barracks	1,900.000	2,231.185	—	331.185	Excess due to death of contractor, legal proceedings delay, and employing another contractor at increased rates and maintainance of surveillant beyond time for completion.
3	Giza	Merkez and Police Barracks	2,800.000	3,027.530	—	227.530	£E.147—deducted as penalty for delay. Extra work ordered by Ministry of Interior.
4	Giza	Elephant House	1,774.000	1,700.000	74.000	—	
5	Giza	Atelier de Photographie	2,048.000	1,870.000	177.422	—	
6	Sennures	Abattoir	520.000	519.000	1.000	—	
7	Magaga	Abattoir	786.000	745.581	40.419	—	
8	Giza	Lion House	4,510.000	4,329.443	190.557	—	
9	Fayum	Tanzim Office and Inspection Rooms	1,442.000	1,437.981	4.019	—	
10	Sohag	Tanzim Office and Inspection Rooms	1,952.000	1,978.000	—	26.000	Excess due to drainage works and other small items not included in Contract and charged to repairs budget.
11	Giza	Pyramids Police Station	1,446.000	1,353.869	92.131	—	
12	Kena	Pumping Station and water supply	3,091.800	4,110.122	—	1,018.322	Account not definitely settled.
13	Giza	Addition and alteration Director's House, Zoological Gardens	700.000	712.000	—	12.000	Special grant £E.700.
		Eight fire engine stations	900.000	610.206	for 7 completed	—	Special grant £E.1,200 (Biba, Somalut, Abu-Kurkas, Nag-Hamadi, Luxor, Itsa, Sennures and Girga).
		Total £E.	29,369.800	29,820.806	933.659	1,615.032	Total excess £151.933.

LIST OF BUILDINGS LET TO CONTRACT IN 1901 AND STILL UNDER CONSTRUCTION.

1	Beni-Souef	Markaz Police Barracks	4,500.000	—	—	—	To be completed February, 1902.
2	Esna	Markaz Police Barracks	2,817.000	—	—	—	" February, 1902.
3	Giza	Agricultural School	17,953.000	—	—	—	" December, 1902.
4	Giza	Director's House, Agricultural School.	2,000.000	—	—	—	" March, 1902.
5	Ayat	Tribunal	3,255.000	—	—	—	" December, 1902.
6	Aswan	Pumping Station, and water supply	2,757.000	—	—	—	" March, 1902.
		Total £E.	33,282.000	—	—	—	

TANZIM AND REPAIRS.

Inspection North.

In 1901, the East and West Repairs Inspections were withdrawn from the Tanzim and put into the charge of special Inspectors, with the best results.

As shown in Table No. 1 three new works, costing £E.13,800, were executed by this Inspection. 142 buildings were repaired at an average of £E.103 each, and 428 minor separate repairs account for £E.786. The total expenditure was £E.29,191.

£E.6,000 were spent in 1901 on the completion of the Mubtadaian and Dar el Ulum schools and £E.7,000 on the National Printing Press.

Offices for the new repair Inspectors were constructed at a cost of £E.800.

Sundry works at the Opera House, including alterations to the Orchestra, were completed for £E.600.

Ninety-three Government buildings in Menufieh and Gharbieh were partially repaired for £E.1,500. A new Police Station, estimated at £E.968, is in course of construction at Boroullos.

Five works valued at £E.1,300 were executed for account of the Local Commissions and Sanitary Department (cemeteries). The construction of an iron bridge over the Gaafariyeh Canal at Tanta, at a cost of £E.1,000, was the most important of the Local Commission works.

The Director of Works of the West (Alexandria) Tanzim is a member of the Municipal Committee, and checks the plans submitted by the latter to the Public Works Department. He is, further, Government clearing agent, and has for some years been occupied in opening up and surveying the underground cisterns. Plans of nineteen of the latter were completed in 1901. Three of these were to be preserved as presenting features of Archeological interest.

In 1901, 181 sets of plant, consisting of 13,397 separate articles, were cleared by this Director. An economy of about £E.800 has been made on the rates previously paid.

The North Inspection is responsible for the Tanzim of seventeen towns in Lower Egypt (Table II). The local Tanzim Engineer, in addition to his duties as technical adviser to the Mudir and Local Commissions, is responsible for:—

(1) Normal Tanzim and road work.
(2) Repairs.
(3) Survey State lands for sale—consigning lands to purchaser.
(4) Survey of cemeteries.
(5) Work for Sanitary Department.
(6) Surveys for Technical Service. (Vide Table 7.)

These engineers are both overworked and underpaid, seven of them receiving £E.108 and four £E.144 p.a.

It has become necessary either to increase the present staff (twelve engineers for seventeen towns) or to relieve them of the extra work thrown on them by other Departments.

MUNICIPALITIES AND LOCAL COMMISSIONS.

(Table III.)

Mansura.

The Mansura Municipality issued a balance sheet in December last showing an income for 1901 of £E.(7,186 + 382) 7,568. A credit balance carried forward from 1900 amounted to £E.5,896. Of the amount available, £E.13,464, £E.12,765 was devoted to drains, paving, water supply, lighting by electricity and sundries.

In addition to the introduction of public lighting and road-watering installations, most of the Local Commissions have opened up new streets, fenced in canals and filled up birkets. Considerable improvements have undoubtedly been introduced.

Tanta.

Twenty-two streets have been opened up here since 1894, and three and a half kilometres of road have been macadamised. Seven streets have been provided with footpaths.

Sharp slopes joining streets of different levels have been furnished with stone steps and 128 road name-plates have been fixed.

In 1899, a wooden bridge 10 metres wide was constructed over the Gaafariyeh Canal. A second bridge, built of iron, was added in 1901. It is 8·90 metres wide.

Mehalla Kubra.

A proposal to fill in the Khalig traversing this town was unfavourably reported on by the Contentieux. This Khalig serves alternately as a sewer and a source for the supply of drinking water. It appears that the reparian owners, who now fill their cisterns from this Khalig in flood, could hold the Government responsible for any stoppage of supply. Complaints—in anticipation—have already been received.

Chibin el Kom.

Two public latrines have been constructed here, a novel and useful development.

Much attention has been paid to the planting of trees, and six small public squares with gardens have been created.

Zagazig.

The rain-water pipes which, against our advice and on the score of economy, were here substituted by the Local Commission for tested cast-iron water-pipes and to which I, in my 1900 report, gave two years of life, have already in one year proved useless, and will have to be replaced.

As a general rule, the Local Commissions still show a tendency to prefer luxuries to necessities. It seems absurd to devote a large proportion of the small permanent budget to the introduction of electric light into a town full of poisonous birkets, with no adequate water supply or drainage, and devoid of paved streets, latrines or a well-organised scavenging service.

The Interior might lay down as a rule that these refinements should follow and not precede the introduction of the rudiments of civilisation.

TABLE No. I.

NEW WORKS AND REPAIRS CARRIED OUT BY THE SERVICES ATTACHED TO THE NORTH INSPECTION IN 1901.

MINISTRIES.	Direction of Works.	Repairs.		New works.		Recapitulation or totals.				TOTAL.	
						Directions.		Ministries.			
		No.	Cost.	No.	Cost.	No.	Cost.	No.	Cost.	No.	Cost.
			£E.		£E.		£E.		£E.		
Finance	Cairo Direction.	20	3,700	1	7,000	21	10,700	21	10,700		
	Delta ”	—	—	—	—	—	—				
Interior	Cairo ”	18	1,100	—	—	18	1,100	34	2,140		
	Delta ”	16	1,040	—	—	16	1,040				
Public Works ...	Cairo ”	30	4,800	1	800	31	5,600	35	5,690		
	Delta ”	4	90	—	—	4	90				
Justice	Cairo ”	7	310	—	—	7	310	10	385		
	Delta ”	3	75	—	—	3	75				
Public Instruction...	Cairo ”	40	3,300	1	6,000	41	9,300	43	9,400		
	Delta ”	2	100	—	—	2	100				
Foreign Affairs ...	Cairo ”	2	90	—	—	2	90	2	90		
	Delta ”	—	—	—	—	—	—				
		142	14,605	3	13,800	145	28,405	145	28,405		
						Total...		...	...	145	28,405
To be added:—Small Works under £E.10						Cairo Direction		360	600	428	786
						Delta Direction		68	186		
						Grand total...		...	...	573	29,191

TABLE No. I *bis*.

WORKS CARRIED OUT FOR LOCAL COMMISSIONS, CEMETERIES AND OTHERS.

Services.	No.	Cost.
		£E.
Cairo Direction.	8	600
Delta ”	8	1,300
East ”	38	500
West ”	1	28
Total... ...	55	2,428

RECAPITULATION.

DIRECTIONS DES TRAVAUX.	Repairs and new works.		Small repairs £E.10 and under.		TOTAL.	
	No.	£E.	No.	£E.	No.	£E.
Direction du Caire	120	27,100	360	600	480	27,700
” du Delta	25	1,305	68	186	93	1,491
Grand total					573	29,191

TABLE No. II

SHOWING THE TOWNS SUBJECT TO TANZIM REGULATIONS, AND THOSE ENDOWED WITH MUNICIPAL OR LOCAL COUNCILS.

No. of Order.	TOWNS.	No. of Inhabitants.	REMARKS.
1	Benha	8,462	
2	Zagazig	35,715	
3	Suez	17,173	
4	Mansura	33,580 ⎫	
5	Talka...	6,430 ⎭	(1) The brackets before two or three towns indicate that they have only one Tanzim Office and one agent. In consequence, though there are seventeen towns subject to the Tanzim, there are only twelve Tanzim agents. (2) With the exception of Mansura (No. 4) which has a Municipal Council and the four towns numbered 5, 7, 12, and 17, all the others, twelve in number, are provided with Local Commissions.
6	Damietta	31,288	
7	Port-Saïd...	42,095	
8	Zifta	13,724 ⎫	
9	Mit-Gamr...	12,680 ⎭	
10	Chibin-el-Kom	20,512	
11	Menuf	19,726 ⎫	
12	Kousena	3,747 ⎭	
13	Tanta...	57,289 ⎫	
14	Kafr-el-Zayat	9,854 ⎭	
15	Mehalla-el-Kobra	31,100	
16	Damanhur	32,122	
17	Rosetta	14,286	
18	Alexandria	315,047	Municipality.

TABLE No. III.

SHOWING WORKS CARRIED OUT BY TANZIM ENGINEERS IN 1901—ROAD SERVICE (LOCAL COMMISSIONS.)

TANZIM OFFICES	REPAIRING ROADS												ROAD LIGHTING			USE PUBLIC ROAD				REMARKS.
	Watering		Scavenging			Workmen			Repairs							Rokhsas				
	No. of carts	Area of roads	No. of carts	Area of roads	No. of animals	Number	Salaries	Sundry expenses	Ordinary	Filling	Macadam or paving	Trottoir	Kind of lighting	No. of lanterns	Expenditure on light	Dues	For trade purposes	For materials	Procès-verbaux de contravention	
							£E.	£E.							£E.	£E.	No.	No.	No.	
Zagazig	9	138,460	6	229,452	15	80	833	959	95,834	—	—	182	Petroleum ..	202	506	103	168	—	3	Mansoura is provided with a Municipality. The road repairs and lighting of Ismailia and Port-Tewfik are looked after by the Canal Co. for a sum £E.2,122 on the P.W.D. Budget. Quesna and Rosetta have no Local Commissions and Tanzim.
Suez	6	95,083	3	131,336	10	42	796	921	4,598	6,908	784	450	Mineral Oil †	135	735	99	153	13	—	
Benha..	3	40,000	15	83,300	6	25	327	513	5,790	493	2,700	—	Petroleum ..	76	144	15	13	14	3	
Port-Saïd	12	259,463	71	835,858	24	99	2,371	4,310	3,824	7,291	259,446 *	—	Gas	338	2,282	262	485	17	156	
Damanhur.. ..	10	52,000	8	72,700	10	44	1,106	589	4,990	348	1,080	—	Potroleum ..	180	361	54	55	26	—	
Damietta	4	31,647	4	270,648	8	35	336	1,243	11,480	11,480	14,474	2,658	Petroleum ..	339	344	62	76	6	16	
Chebin-el-Kom	5	50,000	2	179,100	9	28	493	691	1,250	5,400	—	—	Mineral Oil	75	377	30	61	1	26	
Kafr-el-Zayat ..	3	52,485	3	62,085	5	16	422	138	1,323	1,323	—	—	Mineral Oil	75	411	68	124	1	36	
Tanta .. ., ..	9	133,364	6	151,850	11	44	921	2,112	3,415	3,415	3,604	200	Petroleum ..	318	701	497	785	43	155	
Zifta	5	52,409	3	89,500	9	28	396	266	11,776	520	—	12	Mineral Oil	100	488	40	49	20	2	
Mit-Ghamr ..	4	30,705	4	58,123	7	28	367	246	55,007	6,454	—	16	Mineral Oil	80	464	33	70	—	2	
Mehalla-Kobra..	4	64,525	1	150,714	6	30	349	298	78,435	1,379	1,278	—	Petrolenm ..	162	383	162	139	159	23	
Menuf ,. ..	1	10,000	1	98,779	3	16	129	198	560	2,500	—	—	Mineral Oil	30	23	6	3	1	5	

* A strip 10 metres wide of each road in macadamised.

† "Mineral Oil" indicates Croizat patent lamps.

TABLE No. III *(continued.)*

SHOWING WORKS CARRIED OUT BY TANZIM ENGINEERS—SUNDRY WORKS.

TANZIM OFFICES.	Correspondence.		Engineers absent on duty.		SUNDRY WORKS.								REMARKS.
					Engines.		State Buildings.		Sanitary Service.		State Buildings.		
	For-warded.	Received.	Nights.	Days.	Contra-vention.	Plans.	Plans.	Plans and Reports.	Plans of cemeteries	Gauges of water level in wells.	By Direction of Works.	For Local Com-missions } Projects and Contracts.	
	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.				
Zagazig	1,408	1,314	2	82	—	20	15	25	32	55	—	1	
Suez	945	942	—	142	—	—	—	9	1	48	4	10	
Benha...	520	486	2	30	—	8	15	11	16	—	—	13	
Port Said	1,599	1,478	21	30	—	2	1	12	2	—	2	—	
Damanhur...	1,252	878	11	96	1	28	7	—	71	48	10	—	
Damietta	1,670	1,192	—	—	—	—	—	—	—	—	22	26	
Chebin-el-Kom	1,027	930	15	120	—	5	3	1	12	48	2	2	
Kafr-el-Zayat	499	518	—	—	—	7	2	8	—	—	5	2	
Tanta	1,342	1,109	21	96	—	9	36	12	27	46	6	5	
Zifta	616	565	6	10	—	1	6	10	3	—	4	5	
Mit Ghamr..	379	378	2	4	—	1	8	15	3	—	4	3	
Mehalla Kobra...	507	545	30	70	6	12	—	23	30	—	7	—	
Menuf...	—	—	—	—	1	—	—	1	18	—	2	2	
Kousena	—	—	—	—	—	—	—	1	—	—	—	—	
Mansura	1,407	1,404	6	70	—	26	2	—	25	—	9	—	
Rosetta..	210	209	8	7	—	1	—	—	2	—	—	—	

TABLE No. III *(continued.)*

SHOWING WORKS CARRIED OUT BY TANZIM ENGINEERS—ALIGNMENT OF FAÇADES AND BUILDINGS BORDERING PUBLIC ROADS.

TANZIM OFFICES.	ROKHSAS FOR FRONTAGE.					DANGEROUS STRUCTURES.		SURVEYS OF LANDS OF ZIADET TANZIM.				REMARKS.
	Dues.	Buildings.	Repairs.	Reports.		Demolition Orders.	Contravention.	Land enclosed in the Tanzim alignment to be sold.		Land out of Tanzim alignment to be expropriated.		
				Of Enquiry.	Of Contravention.							
	£E.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Area, M^2	Number.	Area, M^2	
Zagazig	63	107	102	179	5	50	11	13	110	16	99	
Suez	58	25	70	97	—	—	—	8	202	3	27	
Benha...	37	56	32	72	5	28	—	8	54	34	507	
Port Said	95	266	142	405	1	18	—	—	—	—	—	
Damanhur...	73	160	67	51	5	9	2	39	23	11	111	
Damietta	62	109	83	165	11	68	31	33	8,231	7	100	
Chebin-el-Kom	47	117	61	158	46	80	20	4	25	103	1,316	
Kafr-el-Zayat	21	27	12	38	—	21	21	—	—	1	7	
Tanta	85	156	154	223	5	22	5	23	214	8	15	
Zifta	27	54	35	83	—	50	27	—	—	4	13	
Mit Ghamr	53	95	33	110	1	24	12	—	—	5	14	
Mehalla Kobra...	86	254	88	197	5	13	13	37	193	—	—	
Menouf	41	92	35	98	8	36	3	8	155	8	132	
Kousena	--	1	—	1	—	1	—	—	—	—	—	
Mansura	81	162	134	257	50	55	14	11	120	35	517	
Rosetta	28	50	38	58	3	47	4	11	206	—	343	

MAINTENANCE AND REPAIRS OF STATE BUILDINGS.

INSPECTION EAST (MR. CHAPMAN.)

The total number of buildings under the Inspection East and occupied by the different Ministries is 154.

Ministry of Interior	70
" Finance	59
" Justice	11
" Instruction	6
" Public Works	8
Total	154

Bearing in mind that funds for thorough repair have never been available, some idea of the present state of dilapidation of Government buildings may be gained by noting that only some twenty buildings date from 1895-1901 and some ten buildings date from 1890-1895. The remainder range back as far as 1833.

From fifteen to twenty date from between 1833-1860.

It may be said that all the older buildings are more or less defective in construction. There is generally no damp-course; the foundations consist of inferior material; and the walls, though thick, have no bond and contain enormous joints of fat lime-mortar. The timbers, as a rule, are too light for the spans.

When old roofs were found to have sagged it was the custom to prevent the accumulation of water from rain and consequent leakage by thickening up the roofing material, thus filling the hollow produced.

The inevitable result of this practice was to cause the collapse of the roof.

Most of these old roofs are heavily loaded with earth on which is laid a coating of mortar, etc.

They require complete reconstruction. The state of some of these buildings is such that satisfactory and lasting repairs are impracticable. All that can be done is to patch them until funds for complete reconstruction are available.

Very heavy expenditure would be necessary to put the older buildings into a proper state of repair.

The sanitary arrangements are of the most primitive nature and should be entirely remodelled.

The following sums were spent on sixty-five separate works in 1901:—

	£E.
Ministry of Interior	2,060
„ Finance	1,284
„ Instruction	931
„ Justice	447
„ Public Works Department	303
	5,025

The total cost of surveillance came to £E.206 or a little over 4%.

Out of £E.5,025, £E.3,681 were spent on alterations asked for by the Ministry occupying the building:—

	£E.
Ministry of Interior	1,544
„ Finance	908
„ Instruction	675
„ Justice	355
„ Public Works	199
	3,681

Leaving for actual maintenance repairs only £E.*1,344*, a sum totally inadequate.

£E.425 were expended on sanitary work, as under:—

	£E.
Ministry of Interior	66
„ Justice	359
	425

The new latrines at the Mansourah Moudirieh, which will be paid on next year's budget, cost £E.340.

	£E.
In addition to the above works have been executed on special credits given for extensions and alterations to the amount of	5,670
Extra work added during construction (Money found by Public Works Department)	302
	5,972

The cost of surveillance equals £E.302 or 5% about.

During the year there has been considerable improvement in drawing and preparation of details.

The engineering staff is very weak, but some slight progress in knowledge of general principles has been made.

The total number of drawings made amounted to 118.

As stated elsewhere, considerable delay is caused when making projects owing to the want of correct general plans of the buildings. These plans have been brought up to date as far as possible.

In 1901 general plans for seventeen buildings have been made.

MAINTENANCE AND REPAIRS OF STATE BUILDINGS.

Inspection West (Mr. Ehrlich.)

£E.12,815 were spent on repairs this year against £E.4,178 in 1900. £E.3,986 of the first sum figures as a special credit. The most important items are given in annexed List A.

The total of individual and separate works amounts to 161 (vide Statement B).

Mr. Ehrlich has entirely completed the conversion of the Alexandria Série des prix for masonry and woodwork. The revised rates are 8% lower than the old. A further reduction of 2% was obtained from the new Government Contractor for Alexandria. Owing chiefly to the difficulty experienced in obtaining railway trucks for transport, we were obliged to pay 6% increase on our prices for the Province of Behera.

Mr. Ehrlich has further completed the revision and remodelling of the old specifications, and has finished new and exact plans of ten old public buildings.

The heaviest drain on our repairs budget is due to the necessity for reconstructing enormous surfaces of leaky roofs. Almost all the roofs of the old public buildings in Alexandria are constructed as follows:—

(1) Top layer of lime, sand and Kosremil	0·05	metres thick.
(2) Concrete (lime, sand and metal)...	0·35	„
(3) (Occasionally) sea-weed	0·05	„

The weight of this covering is enormous, varying from 0·500 to 0·550 kilos per square metre, or say 200 kilos per square metre heavier than our new roofs. The ends of the joists being almost invariably bricked up, so as to exclude the air, rot away and frequently suddenly give and lead to the collapse of the floor or roof. This occurred in the Ras-el-Tin Palace kitchen. Owing to the enormous weight of the roof-covering acting on joists unsupported by wall-plates and resting generally on a levelling course of spalls, differences of level of 0·50 metres were discovered on baring the roof joists of the old Alexandria Custom House.

In consequence of these abnormal circumstances, separate estimates are now prepared for demolition and reconstruction of roofs.

It was found necessary to change the Custom House and Quay rain-water percolating pits to the "Stanch" system. The mean R.L. of the Quay is 2·50 and the highest sea R.L. 1. Allowing 0·50 for capillarity, the absorbing stratum is only 1 thick. In consequence, the pits existing in the main hall have for years been pumped out during the winter to avoid inundation.

At the Quarantine Teftiche a sewage pit had been constructed on the percolating system with its floor at 1·26 below max. sea-level. It was, of course, always full of water.

(A)

Alexandria.

	£E.
1. Roof, old Customs Stores...	1,800
2. Paving road, Parcel Post...	330
3. Painting Custom House	350
4. Modifications to Caracol, Moharram Bey	250
5. Repairs, tobacco stores	1,500
6. Reconstruction latrines and stairs, old Zaptieh	350
7. Reconstruction roof, Ras-el-Tin School...	500
8. Reconstruction roof, Princesses block, Ras-el-Tin Palace...	575
9. Reconstruction roof, block A and F, Ras-el-Tin...	1,627
10. Construction seven kiosques and Verandah at Custom House	998

Damanhur.

11. Repairs, Moudirieh, Mahkameh Charieh and Moudir's room	750
12. Construction of Inspection House	1,237
Total of chief works...	£E.10,267

(B)

MINISTRIES.	Under 200.		Over 200.		Total per Ministry.	
	No.	Sum.	No.	Sum.	No.	Sum.
		£E.		£E.		£E.
Finance	5	4,978	16	649	21	5,627
Interior	2	1,000	15	838	17	1,838
Public Works	1	1,132	5	285	6	1,417
Justice	1	350	—	—	1	350
Public Instruction	2	500	2	53	4	553
Palace, Ras-el-Tin	3	1,490	3	262	6	2,202
On 1902 credit	—	—	106	292	106	292
	—	—	—	536	—	536
	14	9,900	147	2,915	161	12,815

DRAWING OFFICE.

As detailed in the accompanying statement, forty-three projects of an estimated value of £E.268,396 were elaborated in 1901.

One-fifth of this sum represents the amount paid to the staff.

The number of plans furnished came to 1,080.

I have in other years drawn attention to the inherent difficulties which impede the smooth and efficient working of this service.

List of Projects Elaborated in Drawing Office, 1901.

Name.	Estimate.	Completed.
	£E.	
Sanieh School	32,000	10-6-1
Lion house	4,000	23-2-1
Agricultural School	18,000	18-5-1
Director's house	2,700	2-5-1
Professor's house	1,300	19-11-1
Central Fire Brigade	25,000	27-5-1
Post Office, Port-Said	23,000	10-5-1
Tobacco Stores, Alexandria	13,790	24-6-1
School of Law	25,000	10-6-1
Modification of Law Court, Cairo	3,450	29-6-1
Depository for Archives	6,550	3-11-1
Port-Said Gouvernorat	13,280	15-8-1
Sheds for Alexandria	10,000	29-4-1
,, ,, Port-Said	2,000	7-8-1
Tanzim Office, Sohag	2,000	20-2-1
,, ,, Tanta	2,000	27-5-1
,, ,, Zagazig	2,000	27-5-1
Summary Tribunal, Port-Said	5,700	14-11-1
,, ,, Luxor	3,500	27-5-1
,, ,, El-Ayat	3,500	27-5-1
Merkaz, Beni-Souef	2,000	20-3-1
,, Kom-Hamada	2,000	20-4-1
,, Nawa	2,000	27-5-1
,, Esna	2,000	27-5-1
,, Baltim	700	28-12-1
,, Pyramids	—	—
New Cairo Stables	11,000	7-8-1
Model Workshop	10,400	8-12-1
Helwan Observatory	7,255	25-12-1
Chibin-el-Kom School	4,381	15-11-1
Carried forward £E.	240,506	—

NAME.	Estimate.	Completed.
	£E.	
Brought forward...	240,506	
Native Assembly	2,000	10–11–1
Police Station, Darb-el-Ahmar	3,000	filed.
Maspero's house	4,400	15–11–1
Office and Work of Egyptian Museum	7,300	—
Monument of Mariette Pasha	300	—
Native Tribunal Court, Alexandria	—	—
Ezbekieh Garden Casino...	800	filed.
Sultan Hassan Mosque	—	16–11–1
Arab Museum	—	—
Cairo Post Office	—	—
First floor annexe, Tobacco Stores, Alexandria	—	2–10–1
Cages for small animals	420	14–1–2
Tanzim Office, Minia...	3,000	—
Markaz building, Delingat	990	—
Stables for El-Atf	680	—
Inspector's house, Khartoum...	5,000	filed.
Magnetic Observatory*	—	—
Astronomical Observatory*	—	—
Secretary's house, Egypitan Museum†...	—	—
Total ... ... £E.	268,396	—

COPIES OF DRAWINGS SUPPLIED IN 1901.

DESIGNATION.	No. of projects.	No. of drawings.	No. of copies.
For adjudication	34	769	6,022
Sold to Contractors	30	671	2,963
Used on works	—	250	4,205
Annulled owing to alterations	4	92	1,830
Supplied to outside Services	—	—	5,563
	Total Copies...		20,583

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* With Capt. Lyons for examination.

† With Mr. Clifton for examination.

TRAMWAY, ELECTRIC LIGHT, TELEPHONES.

I.—Cairo Tramways.

The working of this service throughout the year has been very satisfactory.

Owing to the drains constructed this year the rain-water did not cause any interruptions or irregularities in the circulation of the cars, as used to be the case in former years. The level-crossing of the Pyramid line with the Upper Egypt main line is to be suppressed, and a bridge is being erected to carry the tramway over the railway line. This work is carried out by the Railway Administration. It was commenced in the Autumn of 1901 and will be completed early in 1902. The branch line leading from the Pyramid line to the entrance of the Zoological Garden has been suppressed.

No new lines have been opened to traffic this year, and the generating plant has not altered since 1899.

Annexed are statistics with regard to the Cairo Tramways.

	June 30th, 1900.	June 30th, 1901.
I.—General.		
Number of years concession	50	
Date of expiry	1946	
II.—Traffic.		
Total number of passengers	11,245,960	14,714,667
Mean daily number of passengers...	30,811	40,315
Mean in p.c. of population, Cairo	5·45	7·07
Trains multiplied by kilometres	2,294,927	2,294,927
III.—Line and Cars.		
Length of single track line in metres	14,783	14,944
Length of double track line in metres	20,854	20,947
Total length of line in metres	35,637	35,891
Number of motor cars	94	94
Number of trailers	59	59
IV.—Financial Data.		
Share Capital ... ... Fcs.	6,000,000	
Gross revenue ... ... Fcs.	1,498,945·69	1,954,304·24
Total cost (indemnity for accidents not included) ... ... Fcs.	804,936·19	1,018,985·84
Costs in p.c. of revenue ... ... %	53·7	52
Interest on shares ... ... %	7·66	7·66
Distributed to Administrators ... ... Fcs.	48,101·79	48,045·38
Balance available for distribution to shareholders ... ... Fcs.	460,000	460,000
Sum carried to Reserve ... ... Fcs.	26,723·22	26,691·88
Gross revenue per car and kilometre ... Fcs.	0·65	0·54

II.—ELECTRIC LIGHT SUPPLY IN CAIRO.

During the year the lamp connections increased by 28 per cent. (as against 23·8 per cent. in the previous year), showing at the end of 1901 an equivalent of 62,500 8 c.p. lamps connected. The number of subscribers has increased by 36 per cent., and 10 kilometres of high and low tension cables had to be laid in order to meet the demand. Before being connected to the mains, high tension cables are always tested by the Public Works Department at a testing pressure of 4,000 volts whereas for low tension cables the maker's testing-certificates are considered as a sufficient guarantee.

In some quarters (Fagalla, Abbassieh) the Company asked for and obtained powers from the Public Works Department to construct a temporary overhead distributing network, as the streets in those places are not in good enough condition to admit of the laying of cables.

Although there is now a continuous day and night supply, the current is not much employed for driving motors (except fan motors). An equivalent of only 19½ H.P. is connected to the Company's mains. This may be explained by the fact, that the current supplied in Cairo is alternating and the monophase alternating-current motor is impracticable in cases where a large starting torque is required, as for elevators, vehicles, etc. The actual capacity of the plant (800 kilowatts) will soon require extension, if the number of subscribers continues to increase in the same proportion.

The year 1901 was the first one since the existence of the Company's plant during which no general breakdown took place in the current supply.

The Khedivial Opera House has an independent generating plant for feeding about 850 incandescent and 6 arc lamps. The plant is worked on contract by a European firm and controlled by this Department as far as public safety is concerned. There has been no failure nor accident during the year.

III.—ELECTRIC LIGHT IN PROVINCIAL TOWNS.

Concessions were granted to representatives of European firms for the electric lighting of streets and distribution of electricity to private subscribers in Tanta, Zifta and Heluan. Tanta and Zifta will be provided with three-phase current from a central generating plant situated between these towns; and it is intended to distribute power for pumping and other purposes along the line. The current will be transmitted at a pressure of 10,000 volts by an overhead line and transformed down to low tension in sub-stations. This will be the first long-distance power transmission in Egypt. The price of electric current for public lighting will be £E.3,500 per annum for 16-c.p. lamps, and the cost per unit to private consumers is not to exceed £E.0.030 at Tanta and Zifta, whereas at Heluan the public lighting will cost £E.2.250 per annum for a 26-c.p. light and the private lighting £E.0.040 per unit.

Schemes for the electric lighting of Fayum, Suez and Damanhur are under consideration.

IV.—THE CAIRO TELEPHONE SYSTEM.

Up to the present time the telephone service of Cairo was conducted through overhead wires and on the earth-return system, but when a through-communication with Alexandria was established, the existing system proved unsatisfactory and metallic circuits with underground cables became a necessity. The original concession not having foreseen this eventuality, the Telephone Company applied to the Government for an additional licence for the transformation of their system. The requisite regulations were drawn up by the Public Works Department at the beginning of the year, sanctioned by the Council of Ministers on February 7th, and signed by the parties on March 13th. The agreement provides that the Government shall be at liberty at any moment to withdraw the licence for underground cables. Single cables may be laid without protecting pipes if they are steel-armoured, but in streets containing more than one cable, they must be laid in solid cement conduits.

In addition to other technical paragraphs, the agreement contains the clauses usually embodied in acts allowing trenching work or pipe laying in public streets, and a new clause stipulating that night service must be introduced at the Company's exchange as soon as 10% of the subscribers apply for it.

In August, the Company laid before the Public Works Department a detailed plan of the proposed underground lines, and after its approval no time was lost in carrying the scheme into effect. The works are being executed by a German firm under the control of the Public Works Department; they will be completed in February, 1902.

HELOUAN WATER SERVICE.

The working of this service for 1901 has been very satisfactory. No complaints have been received either as to insufficient water supply or on account of other causes.

New mains have been laid to supply houses recently built, and at present the whole of the town is supplied direct from the mains. The main delivery pipe has been taken up and cleaned from end to end. In places the pipes were half full of hard sediment.

A large tank has been erected at the pumps for settling the water used for the boilers.

A statement of receipts and expenditure is annexed.

Statement of Receipts and Expenditure for the Helouan Water Service for 1901.

I.—Water Supplied.

	Cubic metres.
Private persons	147,885
Government	105,998
	253,883

II.—Receipts.

	£E.	Mill.	£E.	Mill.
Private persons	2,161	283		
Government	1,324	977		
			3,486	260

III.—Expenses.

	£E.	Mill.	£E.	Mill.
Ordinary working	1,584	491		
Purchase of new pipes	475	285		
New water meters	70	224		
			2,130	000
Gross Profit			1,356	260

GHIZEH AND GHEZIREH.

These services have been working efficiently throughout the year. All the buildings have been repaired and woodwork painted.

1,600 lin. met. of cast-iron pipe has been laid down on the Pyramid road for the use of the Scavenging and Watering Service. This has enabled us to suppress Sakieh No. 2.

A 6½ H.P. oil engine has been purchased and erected to drive the machinery in the workshops.

In addition to repairs to machinery and pumps for Ghizeh, Ghezireh and Helouan, the Cairo steam rollers and all water-meters, taps and pipes used by the P.W.D. in Cairo, orders to the amount of £E.3,028 have been executed. This sum includes making iron principals for the roof of new Boulac stables; changing columns in Mansour Pasha Prison; ornamental railings, Ezbekieh Garden; repairing tools, etc., for the Cairo City Service; work for Survey Department, etc.

From the 1st January, 1901, the work of collecting the water rates was transferred from the Ministry of Finance to this service, and is carried out on the same lines as the Helouan Water Service. I am able to report that there are no arrears.

£E.500 was placed at the disposal of this service (as a trial) for a partial water supply to the town of Ghizeh. Of this sum £E.410 only was expended; 1,418 lin. met. of pipes were laid and a *borne-fontaine* erected in a central position for the sale of water. The prices are low, viz., 5 mill. per cubic metre at the *borne-fontaine*, ½ mill. per skin, and ¼ mill. for gaz-tin of water.

The water service was opened at the end of June. The receipts for July were only £E.4.360 mill., for December the receipts were £E.10; the present pipe system traverses only a small portion of the town. The actual cost price of water is about 1½ mill. per cubic metre.

GHIZEH AND GHEZIREH WATER SERVICE.

Statement of Expenditure and Receipts for the year 1901.

Expenditure.	£E.	Mills.
Ordinary working expenses	4,590	460
Extraordinary Expenses.		
(1) 1,600 lin. met. cast-iron main on Pyramid road	650	064
(2) New 6½ H.P. oil engine for workshops	150	211
(3) New pipes, valves, etc., in stores	283	863
(4) New water metres	120	000
(5) Repairs to buildings	216	382
	1,420	520
Total expenditure	6,010	980
Total receipts	7,098	343
Gross profit	£E.1,087	363

RECEIPTS.

	£E.	Mills.
Government Gardens (Finance)	3,667	417
„ „ (P.W.D.)	168	549
Watering streets and trees	421	000
Museum	90	000
War Office (Zamalek)	18	000
Caracol (Bewley Bey)	20	000
Survey Department	50	000
Agricultural College	234	250
Turf Club, Ghezireh	476	542
Khedivial Agricultural Society	441	423
Daira Prince Hussein	397	722
Daira Princess Fatma Hanem	234	940
Private persons, by metre	878	480
Total	£E.7,098	343

Price of pressure water: for gardens, $1\frac{1}{2}$ mill. per cubic metre; irrigation $4\frac{1}{10}$ mill. per cubic metre; house supply, 5 mill. per cubic metre.

£E.650 was expended last year for new main, Pyramid road; this waters 20,000.09 metres road. No arrangement has yet been made with the Scavenging and Watering Service as to payment.

KASR-EL-NIL, ENGLISH AND BENHA BRIDGES.

The opening and closing for river traffic has led to no accidents and calls for no special remarks.

The replating of the English bridge is finished.

EZBEKIEH GARDENS.

The gate receipts for the year were £E.1,135; this is £E.187 less than in 1900. There are two probable reasons for this falling off in receipts.

I.—Reconstruction of the garden theatre; this work was in hand the whole of the summer.

II.—The very irregular attendance of the Egyptian military band. The sum paid for this band in 1900 was £E.442 whereas in 1901 the amount was £E.212 only.

The yearly expenditure for collecting gate money including Garden Ranger and Cloak-room attendants, is £E.312.

The Garden itself is kept in as good order as is possible, taking into consideration the number of fêtes held every year.

To protect the smaller grass plots from the constant damage, Mr. Curtis as a trial railed some of them round with a small ornamental iron fence. The plot in front of the Boulac gate has been finished at a cost of nearly £E.100. Two large fêtes have since been held without damage to the plants, flowers or grass.

The total expenditure on the Garden for the year was £E.2,244; this includes water and gas lighting.

COMPARISON OF GATE-MONEY RECEIPTS OF THE ESBEKIEH GARDEN FROM 1897 TO 1901.

MONTHS.	1897		1898		1899		1900		1901	
	£E.	Mill.	£E.	Mill.	£E.	Mill.	£E.	Mill.	£E.	Mill.
January	17	590	70	626	56	698	67	394	61	401
February	21	610	129	308	116	989	88	736	131	716
March	26	440	95	486	77	876	117	212	91	968
April	28	970	98	839	102	184	137	449	121	699
May	31	290	137	800	176	018	167	219	153	251
June	42	190	152	171	153	638	170	465	152	943
1st Half-year ...	168	090	684	230	683	403	748	475	712	978
July	34	635	142	391	131	260	124	427	132	391
August	27	185	105	086	128	134	110	221	74	501
September... ...	18	755	112	995	123	328	119	057	67	200
October	18	305	79	971	97	381	81	666	51	991
November... ...	16	705	70	105	68	893	76	298	56	250
December... ...	24	200	60	172	61	488	61	936	58	292
2nd Half-year ...	139	785	570	720	610	484	573	605	440	625
Total... ...	307	875	1255	050	1293	887	1322	080	1153	603

SCAVENING AND WATERING SERVICE.

There has been no increase in the area: as in 1900, 61% of the total area of the City is cleaned and watered regularly. The remaining 39%, "Native Quarters," receives a cleaning once in four days.

No changes have been made in the working establishment during the year.

The total number of animals in the Service is 421.

The price of forage is still abnormally high and to meet the increased expense for this item a reduction has had to be made in the sweepers, etc., employed.

The rolling-stock continues to be made and repaired at the Government Arsenal.

At my request you consented to transfer this Service to the Sanitary Department in 1902.

One of my reasons for suggesting this transfer is the belief that the present Cairo Sanitary Inspectors can in certain cases do the work of our supervising staff. An economy can thus be effected.

The Service will be handed over with a credit balance of approximately £E.1,500 in the shape of stores.

The construction of the rain-water drains should result in very considerable economy in 1902.

LOCAL COMMISSIONS, WATER-WORKS.

The following works of local importance have been executed or projected:—

Aswan Water-works (Completed.)

A 10 H.P. petroleum engine (Tangye) works a 7″ belt-driven geared pump and throws for the present 325 cubic metres per day. About 30 cubic metres per hour can be delivered. The R.L. of low Nile being 84, and that of the top of reservoir R.L. 122·5, the lift, excluding friction, is 37·5 metres. The suction pipe and delivery main are 6″ in diameter and measure 340 metres to the reservoir. From this point a main 2,020 metres in length runs into the town (vide plan). On this length three public taps and five hydrants are placed. Assuming a velocity of only 0·75, the main is large enough to pass double the actual discharge.

The cost of the installation will be about £E. 4,110. Accounts not yet completed.

Kena Water-works (Completed).

2–10 H.P. petroleum engines (one spare engine)—Tangye—works an 8″ belt-driven geared pump and is calculated to throw

72 cubic metres per hour. The R.L. at low Nile is 65·20 and that of the reservoir in town is 80·80 (top water level when full) and the bottom of the reservoir is at R.L. 78·80. The lift (from the centre line of pump to foot valve) is at lowest river level, 6 metres, and the height from centre line of pump to reservoir level is 8·75. The suction and delivery pipes are 8″ diameter, and measure from Nile to pump 180 metres and from pump to reservoir in town 1,500 metres. On this length there are five hydrants for street watering. In the house in town there are twenty 1″ taps for filling girbahs and balasses. The reservoir has a capacity 960 cubic metres.

Owing to running sand the main suction pipes could not be placed lower than R.L. 64·60. The lowest Nile level being 65·20. This necessitated the purchase of a 7 H.P. petroleum engine and a 5″ centrifugal pump. This pump throws from the river into the well, and the main pump works while the auxiliary pump is also at work. The main suction pipe was 10 centimetres above river level on 12th March, so that pumping would have ceased about the beginning of March, had not the auxiliary pump been put in position in time. This auxiliary pump and engine was ordered on the 19th January and was working on the 5th March.

KAAFR ZAYAT WATER-WORKS.

A small installation already exists here, but is of insufficient power.

It was proposed to instal on the Gafariyeh Canal a 4 H.P. petroleum engine and a 4″ force pump to supply 100 cubic metres per day for road watering.

An extension of main 500 metres in length was suggested.

At the request of the Local Commission another project was submitted, comprising the sinking of a well in the dry bed of the old Melawany Canal. This installation was to consist of a 5 H.P. petroleum motor working a Tangye's treble ram pump and lifting to 25 metres. The discharge is calculated at 250 cubic metres per day. The main was to be lengthened by 500 metres.

Up to the present neither of these projects has been accepted.

BENI SUEF WATER-WORKS.

A project for the construction of Water-works was submitted by the Firm of Confalonieri & Co., but was adversely criticised by the Public Works Department and the Sanitary Department.

The Director General of the latter Department states in his letter "that it is his intention to instal an engine and pump to supply water from a well which they have sunk near the town."

CAIRO ROADS, TANZIM AND GAS SERVICE.

The details of the operations of this Service are shown on the attached statements.

DEMOLITION OF DANGEROUS STRUCTURES.

In 1901, 286 demolition orders were sent into the Gouvernorat. Of these only eighty-four have been executed.

Roads.—D.

55,619 square metres of old limestone road were broken up and repaired with basalt. The total area of basalt roads at the end of 1901 was 315,938. 21,740 square metres of earth roads were macadamized with limestone.

The total road area of Cairo is now 2,803,482, of which 1,378,610 is paved and 1,424,871 is unpaved. Our budget enables us to maintain 385,000 square metres or 13·7% of the total area.

Mending roads by hand.—E.

The rate per square metre works out to 0·0112 as against 0·0106 in 1900. 219,504 square metres were repaired at a cost of £E.2,472.

Steam roller repairs.—H. I.

8,669 square metres of road were picked up and relaid with new material at a cost or £E.341 or 0.039 mill. per square metre. This rate is higher by 0·006 than 1900. The difference is attributable to higher rates for transport.

Basalt road repairs.—J. K.

78,827 square metres were repaired to a depth of metres 0·130 at £E.0.433 mill. per square metre.

In 1900, the repairs layer was only 0·086 metres deep and cost £E.0.024.

Reducing to similar terms we have an excess per unit of £E.0.064 in 1901 which is accounted for by the fact that 53 % of the old basalt material had to be replaced as against 37 % in 1900.

Limestone roads reconstructed in basalt 0·144 metres deep.—L. M.

55,619 square metres were repaired in this manner at a cost of £E.3,949 or a unit rate of £E.0.071. This rate shows a slight economy on 1900.

New roads.—N. O.

24,570 square metres of new road were macadamized at a cost of £E.1,778 or a unit rate of £E.0.072 mill.

Asphalt brick roads.

Repairs as the rate of £E.0.050 per square metre were executed to a surface which had been laid down for ten years.

Earth roads.—P.

404,373 square metres of earth roads and footpaths were dressed and levelled in 1901 at a unit rate of $\frac{1}{10}$th millieme.

Kerbs.

17½ kilometres of kerb were repaired and dressed at a cost of £E.321 which equals a unit rate of £E.0.0183 per lineal metre.

Gardens and Nurseries.—R.

Watering trees.

	1900.	1901.
No. trees watered...	95,556	106,329
Volume of water per tree per watering ... ... Sq. Met.	0·544	0·462
Cost per tree and watering... ... ... £E.	0.0085	0.0084

Trimming, Planting and Transplanting.

	1900.	1901.
No. of trees treated	6,398	9,771
Cost per tree p.a. ... ... £E.	0.1149	0.0782

The cost of pruning necessarily fluctuates in proportion to the size of the tree treated.

The total area of gardens and squares (ex-Ghizeh) is 99,178 square metres, of which 53,000 square metres are watered with the Company's water and 46,178 by sakiehs and overflow of fountains.

For water (1·7 cubic metre per metre).	13·6	mill. per square metre.
All other expenses	12·9	„ „ „
Total	26·5	mill. per square metre of water taken from Water Co.

The total amount spent was £E.1,996.

Ghezireh Grotto.

£E.2,398 were spent in 1901, of which £E.530 represent up-keep. The balance of £E.1,868 was devoted to earthwork and consolidation of the foundations, cement-rendering, building fish tanks and laying out the garden.

Quarries.—S.

On statement S are given the names of the quarries from which we have drawn our supplies of road metal and sand.

Special Works.—U.

Of special works the most important was the construction of the Rod-el-Farag Sahel road. A credit of £E.5,390 was opened by the Caisse for this purpose.

The work done in 1901 is indicated in Statement U.

D.

YEAR	AREA OF DIFFERENTLY PAVED ROADS.					Grand total of paved roads. VI	Total of earth roads. VII	Total roads' area of Cairo. VIII
	Old roads, inferior macadam. I	Old roads transformed, basalt to macadam. II	Earth roads transformed to limestone macadam. III	New limestone roads. IV	Asphalt brick roads. V			
To end December, 1900... ...	973,323·29	260,319·71	82,143·35	31,771·76	6,482	1,354,040·31	1,427,701·45	2,781,741·76
In 1901...	917,704·26	55,619·03	2,829·80 Deduct from column III	71,740·43	—	24,570·23	2,829·80	—
			Add to column VI.					
Add new roads to total road area	—	—	—	—	—	—	—	21,740·43
Total, end December, 1901...	917,704·26	315,938·74	84,973·35	53,512·19	6,482	1,378,610·54	1,424,871·65	2,803,482·19

E.—Repairs by hand-labour.

Year.	Area repaired.	Material.				Labourers.		Sakkas and fantass water carriers.		Carts.		Total Sums.
		Stone.	Sand.	Water.	Sum.	Days.	Sum.	Days.	Sum.	Days.	Sum.	
1901	219,504	7,580	2,093	2,714	1,150	11,179	559	2,413	149	3,995	614	2,472
		9,673										
1900	205,168	6,446	1,768	2,465	1,022	10,327	519	2,070	124	4,164	500	2,165
		8,214										

H.—Steam Roller Repairs.

Year.	Repaired. Area	Material.				Labour.		Fantass.		Carts.		Steam roller.		Total amount.
		Stone.	Sand.	Water.	Sum.	Days.	Sum.	Days.	Sum.	Days.	Sum.	Days.	Sum,	
1900	47,250	4,815	1,001	2,089	850	4,146	262	229	28	1,147	141	166	273	1,554
		5,816												
1901	8,669	981	125	353	183	997	62	107	16	283	35	31	44	341
		1,106												

	1901	1900
1. Depth stone, per square metre...	981: 8,669 = 0·113	0·102
2. Proportion of sand per cubic metre of stone... ...	125: 981 = 0·129	0·208
3. Cube of water used	353: 981 = 0·360	0·434
4. Cube of water used per square metre repaired ...	353: 8,669 = 0·041	0·044
5. Mean surface repaired per day of workman ...	8,669: 997 = 8·69	11·39
6. Mean surface watered per day of fantass	8,669: 107 = 81·01	206·33
7. Mean cube transported per day of cart...	1,106: 283 = 3·608	5·070
8. Load of cart per journey	24: 7,816 = 3·071	2·361
9. Mean surface rolled per day of steam roller ...	8,669: 31 = 279·64	284·64
10. Total mean cost price of rolling	44: 8,669 = 0·0051	0·0058
11. Total mean cost price per square metre of repaires	341: 8,669 = 0·039	0·033

I.—Percentage Table.

Year.	Material, stone, sand, water. %	Labour.				Rolling. %	Cost price per square metre.
		Men. %	Fantass. %	Carts. %	Total. %		
1901	53·7	18·5	4·7	10·2	33·4	12·9	0·039
1900	54·7	16·8	1·8	9·1	27·7	17·6	0·033

J.—BASALT REPAIRS.

YEAR.	Area repaired.	Material				Men		Fantass		Carts		Steam roller.		Kilometre tons		Total Amount.
		Stone.	Binding.	Water.	Sum.	Days.	Sum.	Days.	Sum.	Days.	Sum.	Days.	Sum.	per M^2 of roads.	per M^3 of material.	
		C.M.	C.M.	C.M.	£E.		£E.		£E.		£E.		£E.			£E.
1901	97,103	12,719	1,557	4,000	2,263	12,404	727	594	100	2,587	440	233	694	0·865	6·303	4,224
1900	78,827	6,834	624	2,269	662	7,368	405	382	46	2,493	299	203	441	0·597	6·736	1,883

	1901.		1900.
1. Depth stone, per M^2	12,719: 97,103 =	0·131	0·086
2. Proportion of material of aggregation per M^3 of stone	1,557: 12,719 =	0·122	0·091
3. Cube of water used	4,000: 12,719 =	0·314	0·332
4. Cube of water used per M^2 repaired	4.000: 97,103 =	0·041	0·029
5. Mean surface repaired per day of workman... ...	97,103: 12,404 =	7·83	10·85
6. Mean surface watered per day of fantass	97,103; 594 =	163·47	206·35
7. Mean cube transported per day of cart...	14,276: 2,587 =	5·518	2·996
8. Load of cart per journey	24: 11,036 =	2·174	4·005
9. Mean surface rolled per day of steam roller ...	97,103: 233 =	416·75	388·31
10. Mean cost price of rolling	694: 97,103 =	0·0071	0·0056
11. Total mean cost price per M^2 repaired	4,224: 97,103 =	0·043	0·024

K.—PERCENTAGE TABLE.

YEAR.	Material stone, water, binding %	LABOUR.				Steam roller %	Cost price per M^2
		Men. %	Fantass %	Carts %	Total %		
1901	50·6	17·2	2·4	10·4	30	16·4	0·043
1900	36·8	21·5	2·4	15·9	39·8	23·4	0·024

L.—ROADS RECONSTRUCTED IN BASALT.

YEAR.	Area.	Material.				Work performed by carts.						Fantass.		Water.		Labour and inspection.		Sundry purchases and repairs.	Roller.		Tons & kilom.		Total expenditure.
		Basalt.	Old stone.	Binding.	Amount.	Basalt.	Binding.	Earth or old stone.	Total.	Days.	Amount.	Days.	Amount.	Cube.	Amount.	Days.	Amount.		Days.	Amount.	Per M^2 of road.	Per M^3 material.	
		C.M.	C.M.	C.M.	£.E.	C.M.	C.M.	C.M.	C.M.		£.E.		£.E.		£.E.		£.E.						
1901	55,619	6,707	1,292	1,261	1,700	6,707	1,261	1,292	9,260	2,216	1,019	480	70	3,332	27	9,442	568	60	266	505	0,605	4,204	3,949
1900	54,145	5,908	—	1,266	1,899	5,908	1,266	—	7,174	3,617	434	360	43	3,363	27	9,261	518	65	183	398	0,960	8,800	3,384

	1901	1900
1. Depth stone per square metre...	7,999: 55,619 = 0·144	0·109
2. Proportion of binding per cubic metre of stone ...	1,261: 7,999 = 0·158	0·214
3. Cube of water used per cubic metre of stone ...	3,332: 7,999 = 0·417	0·569
4. Cube of water used per square metre of road ...	3,332: 55,619 = 0·060	0·062
5. Mean surface per day	55,619: 9,442 = 5·90	1·85
6. Mean surface watered per day of fantass	55,619: 480 = 115·87	150·40
7. Mean cube transported	9,260: 2,216 = 4·178	5·983
8. Load of cart per journey	24: 8,356 = 2·872	6·051
9. Mean surface rolled per day	55,619: 266 = 209·09	295·87
10. Cost price material per square metre	1,700: 55,619 = 0·0306	0·0352
11. ,, workmen	568: 55,619 = 0·0102	0·0095
12. ,, carts	1,019: 55,619 = 0·0183	0·0080
13. ,, fantass and water	97: 55,619 = 0·0017	0·0013
14. ,, sundry purchases	60: 55,619 = 0·0001	0·0012
15. ,, roller...	505: 55,619 = 0·0091	0·0073
16. Total mean cost price	3,949: 55,619 = 0·0710	0·0625

M.—PERCENTAGE.

YEAR.	Material, stones, sand %	Carts %	Fantass and water %	Labour %	Sundry expenses %	Roller %	Total cost price.
1901	43·1	25·8	2·5	14·4	1·5	12·7	0·071
1900	56·1	12·8	2·1	15·3	1·9	11·8	0·0625

N.—NEW ROADS ROLLED BY STEAM ROLLER.

YEAR.	Area.	Material.				Labour.		Fantass.		Carts.		Roller.		Total Amount.
		Stone.	Sand.	Water.	Amount.	Days.	Amount.	Days.	Amount.	Days.	Amount.	Days.	Amount.	
					£E.		£E.		£E.		£E.		£E.	£E.
1901	24,570	4,909	828	2,155	1,109	4,254	245	269	41	902	138	180	245	1,778
		5,737												
1900	7,014	1,037	319	353	197	1,038	55	56	7	366	44	37	51	354
		1,256												

	1901		1900
1. Mean depth stone per square metre	4,909: 24,570 =	0·200	0·148
2. Proportion of sand per cubic metre of stone ...	828: 4,909 =	0·169	0·211
3. Cube of water used per cubic metre of stone ...	2,155: 4,909 =	0·439	0·340
4. Cube of water used per square metre of road ...	2,155: 24,570 =	0·088	0·050
5. Mean surface per day of workman	24,570: 4,254 =	5·77	6·75
6. Mean surface watered per day of fantass	24,570: 269 =	91·34	125·25
7. Mean cube transported per day of cart...	5,737: 902 =	6·360	3·432
8. Load of cart per journey	24: 12·720 =	1·887	3·496
9. Mean surface rolled per day of steam roller ...	24,570: 180 =	136·50	189·57
10. Mean cost price per roller	245: 24·570 =	0·0099	0·0070
11. Total cost price per square metre	1,778: 24,570 =	0·072	0·0505

O.—PERCENTAGE.

YEAR.	Material, stone, sand, water %	LABOUR.				Roller %	Cost price per sq. metre.
		Men %	Fantass %	Carts %	Total %		
1901... ...	62·4	13·8	2·3	7·7	23·8	13·8	0·072
1900... ...	55·7	15·5	2·0	12·4	29·9	14·4	0·0505

P.—LEVELLING OF EARTH ROADS AND FOOTPATHS.

YEAR.	Levelling.		Working days.		Days carts.		Days watering by hand.		Cube of earth.		Amounts.	
	Roads.	Footpaths.	Roads.	Footpaths.	Roads.	Footpaths.	Roads.	Footpaths.	Carried.	Transported.	Roads.	Footpaths.
1901... ...	366,337	38,036	4,721	734	656	233	12	36	2,060	4,864	401	93
	404,373		5,455		889		48		6,924		494	
1900... ...	316,844	156,477	3,110	1,417	465	417	7	30	445	5,287	264	204
	473,321		4,527		882		37		5,732		468	

	1901.	1900.
(a) Cost price, levelling roads, square metres	401: 366,337 = 0·0011	0·00083
(b) " " footpaths...	93: 38,036 = 0·0024	0·0013
(c) Area levelled per day and man, roads	366,337: 4,721 = 77·60	101·88
(d) " " " footpaths	38,036: 734 = 51·82	110·43
(e) Area watered per day and man, roads	3,188: 12 = 265·66	474·00
(f) " " " footpaths	8,204: 36 = 227·88	449·57
(g) Average cube carted per day	6,924: 889 = 7·788	6·499
(h) Average pay of workman	351: 5,455 = 0·064	0·080
(i) Cube detritus removed	4,864: 2,060 = 2·804	4·842

R.—Public Gardens.

Designation.	Year.	Number of		Inspection.		Raïs.		Labourers.		Gaffirs.		Carts.		Carts.		Fantass.		Mould.	Water Cy. & Sakkia.		Plants purchased.	Sundry expenses.	Total amount.
		Trees.	Plants.	Number.	Amount.	Number.	Amount.	Days.	Amount.	Days.	Amount.	Days.	Amount.	Days.	Amount.	Days.	Amount.	Carted.	Cube.	Amount.			
Watering trees	1901	106,329	—	—	—	1	36	2,183	109	—	—	—	—	—	—	2,464	378	—	49,090	374	—	—	897
	1900	95,556	—	—	—	1	36	1,652	83	—	—	—	—	—	—	2,645	317	—	51,993	381	—	—	817
Pruning, up-keep of trees, planting, potting, etc. ..	1901	9,771	—	—	—	1	42	6,115	309	1	30	764	139	431	60	—	—	1,850	—	—	—	184	764
	1900	6,398	—	2	38	1	10	3,519	167	—	—	850	134	—	—	—	—	—	—	—	—	386	735
Gardens and Squares.. ..	1901	—	—	1	108	2	78	7,603	397	2	54	145	46	609	91	—	—	1,635	90,100	721	490	11	1,996
	1900	—	—	1	107	2	72	7,607	392	2	54	108	19	1,096	131	—	—	1,620	85,876	687	232	176	1,870
Ghezireh Grotto	1901	—	—	1	102	1	24	15,428	876	2	38	—	—	829	137	—	—	—	x	x	87	1,134	2,392
	1900	—	—	1	90	1	18	1,801	90	2	33	77	14	137	22	—	—	424 digging & filling	x	x	220	467	954
Fountains	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	29,891	239	—	—	239

	1901	1900
Watering Trees.		
1. Cube of water per watering	49,090: 106,329 = 0·462	0·554
2. Number of waterings per man and per day	106,329: 2,183 = 49·000	58·000
3. Cost price of watering in labour and inspection	(36+109): 106,329 = 0·0014	0·0012
4. Cost price of watering per day of fantass..	378: 106,329 = 0·0035	0·0033
5. Cost price of water per watering	374: 106.329 = 0·0035	0·0040
6. Total cost price per watering..	897: 106,329 = 9·0084	0·0085
Pruning, upkeep, etc.		
7. Number of trees per workman per day	9,771: 6,115 = 1·60	1·81
8. Cost price of labour, guardians and inspection	(42+309+30): 9,771 = 0·0390	0·0336
9. Cost price per day of carts	(139+60): 9,771 = 0·0204	0·0210
10. Cost price in sundry supplies..	184: 9,771 = 0·0188	0·0603
11. Total cost price	764: 9,771 = 0·0782	0·1149
Gardens and Squares.		
12. Area per workman day	99,178: 7,603 = 13·05	13·02
13. Cost price per M² in labour, guardians and inspection	637: 99,178 = 0·0064	0·0063
14. Cost price per day of cart	137: 99,178 = 0·0014	0·0015
15. Cost price per plants and supplies	501: 99,178 = 0·0051	0·0041
16. Total cost price per M² (for Nos. 13, 14 and 15)	1,275: 99,178 = 0·0129	0·0119
17. Cube of water used per M² per annum	90,100: 53,000 = 1·700	1·620
18. Cost price watering per M² per annum	721: 53,000 = 0·0136	0·0130
19. Total cost price per M² including watering	0·0129+0·0136: = 0·0265	0·0249

S.—QUARRIES.

MATERIAL.	Tourah.	Abbassieh.	Abou Zaabal.	Total.	Sand, Abbassieh.
1901. Road metal and sand ...	1,543	9,464	18,138	2,9145	6,574
1900. „ „ ...	2,298	3,349	10,488	16,135	7,926

U.—CONSTRUCTION OF A ROAD LEADING TO THE SAHEL OF ROD EL FARAG ON A SPECIAL CREDIT OF £E.5,390 GIVEN BY THE CAISSE DE LA DETTE PUBLIQUE.

The work done in 1901 is as follows:—

	£E.	Mill.
1. Earthwork, 25,626 cubic metres	745	164
2. Cement culvert	9	728
3. Macadam, length 1,826·80 lineal metres, area 14,309·45 square metres	1,929	078
4. Construction of six pits for water meter £E. 19.250 Cost of metres ... ... „ 134.222	153	472
Total...	£E.2,837	435
spent to end 1901. The balance available in 1902, is 5,390 — 2,837 ... ... =	£E.2,553	000

REPORT ON THE GAS SERVICE FOR THE YEAR 1901.

There are now 3,233 gas lamps in Cairo or an increase of 62 compared with last year. The installation of forty-eight of these new lamps was made possible by the economies effected in the Service. A special grant was received for the installation of the other fourteen lamps.

Arrangements are being made for the installation of 295 new lamps in various parts of the City where lighting is most urgently required. A special grant of £E.2,000 p.a. has been given for this purpose, with effect from 1st January, 1902.

No change has been made in the working establishment.

The lighting of the City during the year has been satisfactory. The fines inflicted on the Gas Company amounted to £E.173 or £E.90 less than last year.

CAIRO RAIN DRAINAGE.

The execution of this project was begun on the 7th May, 1901, it being then our intention to allow the water to percolate through the bottom of long culverts constructed on the side-walks. Owing to the danger of possible infiltration into the foundations of the adjoining houses the project was, on the advice of the Director General, Sanitary Department, remodelled and converted to the stanch sewer system. The work was restarted on the 8th June and completed on the 29th November. The total length of the network is 8,055 metres, consisting of—

2,837	metres	masonry sewer,
880	„	concrete pipes,
1,802	„	stoneware pipes,
1,808	„	„ „ „
728	„	junction pipes.
8,055	metres.	

There are 135 gullies, 187 manholes, three syphons and a masonry outfall sluice.

The stoneware pipes were ordered by telegraph from Mr. Doulton, England, and the cement pipes were made in Cairo by Messrs. Guétin & Charvaut. To allow of the completion of this work in five months and a half in face of very considerable engineering difficulties, a great deal of work had to be done at night. Most of the arch centering, the timbering of trenches, and the placing of junctions across heavy traffic streets was executed by lamplight. On no occasion was the running of the tramways arrested. Owing to the change of system having been introduced during construction, the invert on a length of 839 metres had to be constructed by lamplight in a sewer of 1·20 high and 1·00 broad.

The trenching in the native quarters, which in places reached a depth of 5·50 in streets only from 4 to 6 metres wide was especially difficult and dangerous. Heavy timbering was here used, the struts being so close together that the pipes had literally to be threaded into position. Most of the houses having very shallow foundations had to be shored up, an unforeseen and heavy expense and one which will play an important part in any complete Cairo sewage scheme. The cubic metre of excavation here cost 0.258 mill., owing to the difficulty of carrying the earth, basket by basket, along a track sometimes only 1·00 wide and serving for the entire traffic of the street.

Great difficulties were caused by the high level of the infiltration water. Trenching was commenced at the main sewer end, and the latter then served to drain off a portion of the water towards the outfall, where a pump lifted it into the Ismailiyah Canal. Three workmen were unfortunately killed during the progress of the work, one by an earth slip and two by the bursting of a mosque cesspool into an old empty sewer which was being explored. The stench arising from the infiltration water in the native quarter trenches added greatly to the discomfort of the supervising engineers.

All pipes except those constructed on the Monier system are laid on a concrete bed. This is composed of cement when much below infiltration level and of homra when at higher levels. All gulley and manhole pits on the pipe line are made of basalt and cement concrete 0·20 metres thick. The masonry manhole pits are constructed of brick in cement.

The grading of this drainage system necessitated considerable changes in the level of several streets. The Fagallah road was thus raised 0·58 metres on a length of 372 metres.

Owing to the existence of two large water mains in this street our drain had to be placed between the double line of tramway. Traffic was carried on one line but was never suspended.

In spite of all unforeseen expenditure the total cost of this work was only £E.21,174 (ex customs) or £E.3,445 less than my estimate of the 18th June, 1901 (£E.24,619). The rates per linear metre work out as follows:—

	£E.
Remodelling of existing old sewer...	1,650
New egg-shaped sewer	4,320
Monier cement pipes	5,610
Enamelled stoneware pipes 0·45	3,090
” ” ” 0·30	1,425
” ” ” 0·15	0,380
Gully pits including cast-iron cover (each)...	6,620

It is entirely due to the energy and resource of Mr. Reboul and his able assistants, Messrs. Kolheb and Schoechlin, that this difficult piece of work could be completed in the very short period of 206 days. We are further much indebted to the Director General, Sanitary Service, and Price Bey for assistance and advice in the preparation of the project.

TABLE SHOWING WORK DONE DURING PROGRESS OF THE RAIN-WATER DRAINAGE.

CATEGORY.	Earthwork.	Demolition.	Homra concrete.	Cement concrete.	Hydraulic lime concrete.	Brickwork.	Rubble masonry.	Cast-iron.	Cement rendering.	Homra rendering.	Filling.	Ciment armé pipes.	Collars.	Pipes.			Inspection chambers.	Gullies.	REMARKS.
														0·45	0·30	0·15			
Sewers, masonry, old.	10,131·91	560·95	161·31	52·51	206·05	445·75	1,090·07	5,850	4,912·37	8,008·92	5,182·80	—	—	—	—	—	—	—	
Sewers, masonry, new	4,095·11	39·34	189	97·98	—	306·64	196·79	1,820	1,305·95	486·96	2,368·96	—	—	—	—	—	—	—	
Drains, ciment armé .	5,114·46	—	—	114·27	—	21·39	—	2,990	406·20	—	4,431·58	283	260	—	—	—	—	—	
Drains, stoneware pipes 0·45	5,867·11	—	386·62	206·45	—	122·15	—	6,500	782·49	—	4,230·63	—	—	2,282	—	—	—	—	
Drains, stoneware pipes 0·30	3,812·54	—	412·73	71·10	26·84	115·03	—	6,240	446·56	—	2,571·64	—	—	—	2,362	—	—	—	
Gullies and junctions	2,007·39	4·52	74·63	316·53	—	29·58	55·36	27,383	802·51	79·16	1,295·89	—	—	—	25	1,135	—	—	
Kennel	50·99	—	11·33	5·58	—	15·41	—	3,815	95·59	—	—	—	—	—	—	—	—	—	
Total	31,079·51	604·81	1,235·62	864·42	232·89	1,055·95	1,342·22	54,598	8,751·67	8,575·04	20,081·30	283	260	2,282	2,387	1,135	187	133	

Representing 4,339·05 metres.

MASONRY SEWERS.

	Category.	Abutments, vertical.	Invert.	Abutments with batter.	Oval.	Earthwork.	Demolition.	Concrete of			Rubble masonry.	Brickwork in		Rendering in		Filling.	Cast-iron covers.	Remarks.
								Homra.	Hydraulic lime.	Cement.		Homra.	Cement.	Homra.	Cement.			
Main Sewer.	Bue Madabergh	239·00	—	—	—	879·52	76·48	1·20	42·29	1·01	57·81	120·02	—	907·14	548·90	434·98	780	
	Mograby	407·70	—	—	—	1,655·26	159·01	—	122·31	1·17	26·91	206·18	—	1,585·78	833·24	1,084·48	910	
	Place Opéra	—	121·00	—	—	548·77	2·09	186·48	—	00·50	196·79	3·30	—	486·96	263·86	179·08	399	New.
	Taher	—	114·20	—	—	439·67	25·12	22·84	—	00·33	112·17	2·00	—	461·56	230·35	68·52	260	
	From Taher to Waghet-el-Birket..	—	—	976·15	—	4,684·55	178·37	102·49	—	3·02	657·31	31·14	—	4,042·26	2,268·65	2,616·08	2,340	
	From Waghet-el-Birket to Kantaret-el-Dikke	149·90	—	—	—	1,262·62	12·98	16·31	—	45·81	76·78	—	77·76	—	591·24	721·19	650	
	From Kantaret-el-Dikke to Canal Ismailieh	—	—	—	350	3,546·34	37·25	2·52	—	97·48	—	—	303·34	—	1,042·11	2,189·88	1,430	New.
	Sewer Emad-el-Dine Saha ..	202·70	—	—	—	1,012·78	51·66	9·23	41·25	00·84	114·07	7·05	—	749·48	314·47	187·09	650	
	Baidak	77·00	—	—	—	197·51	57·34	9·24	—	00·33	45·02	1·60	—	262·70	125·52	70·66	220	
		1,076·30	235·20	976·15	350	14,227·02	600·30	350·31	206·05	150·49	1,286·86	371·29	381·10	8,495·88	6,218·32	7,551·76	7·670	
												752·39						

DRAIN PIPES IN MONIER CONCRETE, 0·50 DIAMETER.

DESIGNATION.	Length. M.	Excavation. M^3	Brick-work in homra. M^3	Filling. M^3	Cement concrete. M^3	Cast-iron. Kgs.	Cement rendering. M^2	Pipes. No.	Collars. No.	OBSERVATIONS.
Faggalah, bazar copte ...	387·75	2,305·85	17·94	1,984·20	55·24	15·60	182·98	130	118	
Kasr-el-Nil	492·10	2,808·61	3·45	2,447·38	79·03	14·30	223·32	153	142	
Total...	879·85	5,114·46	21·39	4,431·58	114·27	29·90	406·20	283	260	

ENAMELLED STONEWARE DRAINS 0·45 DIAMETER.

CATEGORY.	Length. M.	Excavation. M^3	Homra concrete. M^3	Brick-work. M^3	Filling. M^3	Cement concrete. M^3	Cast-iron. Kgs.	Cement rendering. M^2	Pipes. No.	OBSERVATIONS.
Emad-el-Dine-el-Saha ...	228·38	491·22	30·83	12·09	325·12	11·17	780	53·12	293	
Garden Esbekieh	424·15	1,210·87	119·10	59·51	900·60	5·37	1,560	281·17	537	
Faggalah, bazar copte ...	385·65	1,507·05	107·98	20·31	1,012·92	37·64	1,560	156·35	493	
Faggalah, Jésuite I... ...	90·59	216·76	23·46	15·45	165·62	3·59	390	55·89	100	
Kasr-el-Nil	674·06	2,441·21	105·25	14·79	1,826·37	148·68	2,210	235·96	859	
Total...	1,802·23	5,867·11	386·62	122·15	4,230·63	206·45	6,500	782·49	2,282	

ENAMELLED STONEWARE PIPES, DIAMETER 0·30.

CATEGORY.	Length M.	Excavations. M^3	Homra concrete. M^3	Brickwork. M^3	Filling. M^3	Cement concrete. M^3	Cast-iron. Kgs.	Cement rendering. M^2	Pipes No.	Concrete hydraulic lime.	REMARKS.
Emad-el-Dine-el-Saha ...	382·02	988·29	82·52	7·05	598·89	33·07	1,300	100·80	489	—	
Moliguy	85·24	169·31	17·90	7·63	132·57	4·22	260	35·96	111	—	
Fagallah-bazar copte ...	281·70	308·84	29·41	20·30	132·90	1·17	910	63·84	377	26·84	
Fagallah el Kadimah ...	168·70	254·00	40·74	15·11	174·61	0·67	520	39·28	218	—	
Fagallah-Jésuites I ...	151·42	347·51	37·86	10·93	267·90	0·67	520	24·00	216	—	
„ „ II ...	51·03	82·14	11·01	4·91	60·14	0·34	260	12·00	67	—	
Sébille	284·37	787·77	80·19	36·11	616·72	3·21	1,040	84·84	369	—	
Kasr-el-Nil	404·29	874·68	113·10	12·99	587·91	27·75	1,430	85·84	515	—	
Total	1,808·77	3,812·54	412·73	115·03	2,571·64	71·10	6,240	446·56	2,362	26·84	

GULLIES AND JUNCTIONS.

CATEGORY.	Gullies.	Length of junction.	Brickwork.	Number of pipes.	Homra concrete.	Earthwork.	Cement concrete.	Castings.	Filling.	Cement rendering.	Kilogrammes of iron.	Rubble-masonry.	Homra rendering.	Pipes 0·30.	REMARKS.
Entire network.	133	727·45	29·58	1,135 11 coudes.	74·63	2,007·39	316·53	267·33	1,295·89	802·51	239·40	55·36	79·16	25	

COVERED KENNEL ROAD CROSSING.

CATEGORY.	Length.	Earth-work.	Cement concrete.	Brick-work.	Cement rendering.	Castings.	Homra concrete.	REMARKS.
	118·45	50·99	5·58	15·41	95·59	38·15	11·33	

SUMMARY OF BUILDINGS CONSTRUCTED SINCE 1895.

	Lower Egypt.	Upper Egypt.	Total.
	£E.	£E.	£E.
New Buildings constructed since 1895	470,654	81,224	551,878
New Buildings being constructed ...	189,391	37,291	226,682
	660,045	118,515	778,560

£E.778,560 @ ½%

Additional credit for repairs required... ... ... £E.3,892

REPORT ON THE SURVEY DEPARTMENT

1901

BY

Capt. H. G. LYONS, R.E.,
DIRECTOR-GENERAL, SURVEY DEPARTMENT.

SURVEY DEPARTMENT REPORT, 1901.

Introduction.

The report on the Survey Department in previous years has recorded only the amount of work done, and no description of the methods employed was given, since they were being modified as rapidly as was possible without delaying the work.

During the year 1901 the work has been carried out more systematically than in previous years, since the reorganization effected in 1898 and 1899 has had time to develope and since the revision of the portion of the Revenue Survey which the Government Lands Department had handed over for correction, has been completed.

Hitherto, owing to the intermixture of work of different classes, it has not been possible to form an accurate estimate of the actual cost of survey work. For 1901 this can be done to some extent, but it will not be until 1902 that a really satisfactory discussion of the cost can be undertaken, since the whole of the survey work will then be based on triangulation and carried out on a single definite plan.

The Ministry of Finance, in accordance with the Khedivial Decree of 10th May, 1899, requires that two Mudirias should be ready for the Reassessment of their Land Tax by midsummer at the latest, each year, with the land registers compiled and the maps printed.

This necessitates an outturn from 600,000 to 700,000 feddans* annually, and if every village cannot be reassessed before the end of the year allotted, the imposition of the new tax rates on the whole province is postponed for a year. Thus it is of primary importance that each Mudiria should be completed within the allotted term, so that many expedients have to be adopted to improve the quality of the work without, even temporarily, reducing the outturn.

For instance, Menufia province has been surveyed without triangulation by means of a series of closed polygons traversed with theodolites (the old method) because the reassessment of that Mudiria had to take place in 1902 as well as that of the Fayum, so that the survey could not be delayed till a triangulation was prepared. This is the last province which will be so surveyed, and all others will be properly triangulated. The greatest trouble and delay has been experienced in the traversing, the stage of the work which follows the triangulation and provides fixed points at the rate of about sixteen per square kilometre for the control of the chain survey. These points have been marked hitherto by roughly dressed stones sunk 30-40 centimetres in the ground. There has always been a certain number of them lost by accident or theft and the lines determined by them have to be retraversed, which entails additional expense and a delay to the detail work. Never, however, has this reached such proportions as it has done in the Fayum, where sometimes as many as fifteen and twenty stones were missing from a single village. The village sheikhs are shown the position of the stones when first fixed, and were usually (now invariably) given a descriptive list of them besides, they also signed a receipt for them. The Mudiria took written undertakings from the Omdas that the marks should be respected but these proved worthless; the same removal of marks went on undiminished till the end of the survey, and enough work has been done in the Fayum to survey a province half as large again. In consequence, the preliminary work (Traversing) in Qaliubia and Daqahlia is seven months behindhand owing to the constant re-traversing required in the Fayum, and the staff will have to be doubled at least in order to be ready for the detail survey in time next year.

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*1 feddan = 1·038 acres = 0·4201 hectare. 1 square kilometre = 238·05 feddans.

It appears that local authorities are unable to ensure that the marks should be respected, and therefore the only means of keeping up to the scale of work required by the Finance Ministry is to have a staff employed capable of turning out at least 800,000 feddans annually under favourable conditions, by which means delays such as those mentioned will not endanger the reassessment work.

Another point to which I would specially draw attention is the system still in use in the Mudirias for calculating areas. In many, if not in most, Mudirias the employés who enquire into complaints against survey work can only compute the areas of plots according to the Coptic rules, which date from ancient Egyptian times. According to these, the area of a triangle is equal to the mean of two sides multiplied by half the base, and that of *any* four-sided figure is the product of the means of the opposite sides.

These rules are inaccurate and give results almost always in excess of the true values. In the case of an equilateral triangle the error is $\frac{1}{8}$ of the whole or 12·5% in excess, while for a parallelogram with an angle of 45° the area they obtain is to the correct area as 141 is to 100 or 41% in excess. All old measurements of land were worked out by these rules, and this is an explanation of the large area which has had to be relieved of tax as stated by the Financial Adviser in his note recently published.

The present action of the Mudiria surveyors in reporting the survey results as wrong when compared with those they obtain by the above rules is calculated to discredit the work of the Survey in the country. Great care is taken in calculating the areas of plots, three independent checks being applied.

Any areas corrected by these old methods in the land registers will introduce errors except in the case of rectangular plots; these indeed are largely in the majority, but there are also many irregular, or triangular plots.

The instruction class turned out ninety-two young surveyors during the year, of which ten were messahin from Taftishes who were trained for employment as junior engineers, eight trained in plane-table work to be employed on the revision of topographical maps, while the remaining seventy-three were trained for the chain survey of the Revenue Survey, and one for theodolite traverse work. Of youths so trained about 4 to 5% are subsequently dismissed as not continuing to improve sufficiently, while others resign, not liking field work, and some are promoted to Engineers.

The wastage from all these causes amounts to about forty a year.

The Library of the Department has been increased by a large number of books and maps, mostly presented by the Observatories and Surveys of other countries with whom publications are exchanged.

The total number of books, pamphlets and maps in the Library up to the 31st December, 1901, was 2,788.

During the year there were added :—

	Books and pamphlets.	Maps.
Purchased	151	4
Presented	523	478
Total... ...	674	482

The improvement reported last year in the sale of maps and tracings has been fully maintained, though many more could be sold if it could be brought to the knowledge of the small landowners that they were readily obtainable. One bar to their ready sale is that the charge at the Mudirias for an extract from the registers is 430 milliemes, and without such an extract giving the numbers of their plots, few understand a map sufficiently to locate their own land, so that a proprietor has first to pay the above charge at the Mudiria before he knows which map-sheet (price 50 milliemes) to buy ; this charge of 430 milliemes is the same for all, there not being a sliding scale of fees.

YEAR.	Printed maps.	Publications.	Tracings.	Total.
	£E.	£E.	£E.	£E.
1898	—	—	—	141.5
1899	145·8	—	139.5	285.3
1900	125·8	15.7	426.9	568.4
1901	214·9	48.8	537.6	801.3

Recently a notice has been printed on the back of the Survey statement, given to each landowner, that maps are procurable at 50 milliemes per sheet.

The numbers of maps and publications issued from the map store were :—

YEAR.	Maps		Publications	
	Free.	On repayment.	Free.	On repayment.
1900	20,453	906	1,738	103
1901	24,550	2,847	9,009	235

The free issue of maps is mainly accounted for by the following issues of the village maps of the Revenue Survey :—

Sixteen copies of each map to Finance Ministry.

Three copies of each map to Irrigation Circle concerned.

Two copies of each map to Khedivial Library.

The large number of publications issued free is due to the monthly statements of the meteorological observations which are taken at the different stations and which are supplied to Government Departments, and sent to other observatories and weather services in exchange.

On the 31st December, 1901, there were in the map store 98,000 printed map-sheets and 21,474 books and pamphlets, besides all original maps. etc, The approximate average cost of the survey of a square kilometre from the data given below in this report would be:—

	£E.	Mill.	
Major triangulation	0	039	
Minor triangulation	0	579	
Theodolite traverse	2	200	
Detail survey...	3	399	
Total *	6	217	per square kilometre, or 26·1 mills per feddan.
Besides, the cost of compiling the registers =	2	747	

This may be capable of reduction, but the rate at which work has to be turned out (3,000 square kilometres per annum surveyed on a scale of $\frac{1}{2500}$, printed and published, besides the compilation of the Arabic registers), often necessitates the employment of surveyors who should have longer training. This leads to errors which have to be corrected, and so the expenses are increased.

The department at present is divided as follows:—

I.—Surveying.
II.—Preparation and Reproduction of Maps and Plans.
III.—The Observatory.
IV.—Meteorology and Weather Service.
V.—Geological Survey.
VI.—Analyses, and Testing of Materials, etc.

I.—Surveying comprises:—

(*a*) The parties engaged on the major and minor triangulation.
(*b*) The computing office, where the observations are reduced and checked, and where the field-sheets for the Revenue Survey etc., are projected.
(*c*) The theodolite traverse parties, who do the fixing of points at short intervals after the Minor triangulation.
(*d*) The detail chain survey which is executed on a scale of $\frac{1}{2500}$.
(*e*) Revision of incorrect work, and the bringing up to date of the Revenue maps and preparing them for reproduction on smaller scales as topographical maps.

II.—The Drawing Office receives the field-maps, prepares fair drawings of them when necessary, and reproduces them by lithography or zincography. A considerable number of plans, etc., are reproduced for other Government Departments.

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* This is the actual cost of Survey only, and does not include Inspectors' pay, nor the cost of instruments, materials, or house rent. The cost of computation is likewise omitted, since it could not be separated from much other computing done during the year 1901.

III.—The Observatory—now at Abbassia, but which is shortly to be transferred to Helwan—is at present occupied with the routine work incidental to being the first Order Station of the newly organized weather service, which embraces Egypt and a considerable part of the Sudan. Other astronomical and physical work is also done, but mainly of an experimental nature seeing that new buildings are to be constructed.

IV.—The Meteorological and weather service is directed by Mr. J. I. Craig, who is in charge of the Computing Office, where the Meteorological results are reduced and prepared for publication.

V.—The work of the Geological Survey has been carried out during the year by three geologists, who are engaged in field work during the cooler six months, while the remainder of the year is occupied in the preparation of reports, and the arrangement of the collection in the New Museum.

VI.—The Chemical Laboratory, at first formed for the analysis of rocks and stones collected by the Geological Survey, has recently greatly extended its scope of work by including building materials, soil and water from lands where new irrigation works are in progress, and recently, the testing of cement, together with crushing tests for bricks and building stones.

VII.—The Map Store is occupied with the storage of maps, both originals and the printed editions, as well as the sale of these and other publications to Government Departments and to the public.

Triangulation.

During the year the major triangulation of Dakahlia and Kaliubia was completed, while the minor triangulation was finished early in 1902.

The Brünner standard base bar being still at the Bureau des Poids et Mesures at Paris, Jaderin's wire apparatus was used for measuring a base near Cairo, and a base of verification was measured near Sherbin in the North.

In the autumn Mr. Villiers Stuart commenced the major triangulation in Qena and Girga, which are the next provinces to be surveyed.

Computing Office.

During the year 1901 the Computing Office, under Mr. J. I. Craig, has been employed in the reduction of the minor triangulation of the Fayum, the major triangulation and the bulk of the minor triangulation of Daqahlia and Qaliubia, also the computation of the traverses and preparation of the field traverse maps for the use of the six Taftishes of the Revenue Survey in the markazes of Etsa, Fayum, Quesna, Menufia, Shibin el Kom and Sennures. For the purpose of comparison, however, some details of the major triangulation of the Fayum have been added.

FAYUM MAJOR TRIANGULATION.

The general form of the major triangulation of the Fayum is that of an elliptical ring of central polygons with sides of a mean length of 8,700 metres, the greatest being 16,658 metres and the least 4,004 metres.

The observations were made by Mr. P. Stadler who began work there in November, 1898, and finished in October, 1899. No record was kept of the actual time employed in reconnaissance, but it did not differ much from the half the period, and may accordingly be estimated at about 180 days, the remainder being taken up in observations. The total number of stations was fifty-three and the total area triangulated 2,077 square kilometres. The cost of the whole was £E.678·410 milliemes, made up as follows:—

	£E.	Mill.
Salaries of personnel	463	000
Cost of transport of staff, instruments, materiels,etc.	191	960
Cost of station marks	23	450

To this, however, must be added the cost of the measurement of the base-line, which amounted to about £E.25, making the gross total for the major triangulation £E.703, or £E.0·339 per square kilometre.

The angles were observed with 26-centimetre theodolite by Stärke and Kammerer, provided with micrometers reading to two seconds. The average error of closure of the triangles is 3″·8.

The base-line was measured on the desert south-east of Siala station, where an almost ideal site was obtained. After a reconnaissance the line was staked out, levelled, and the end mark laid down by an advance party in preparation for the actual measurement which was made in August, 1900. A steel tape, which had been carefully verified against a standard metre bar in the Central Office at Giza, was used, and after correction for temperature, tension and sag the following four measures of the base were obtained:—

	Metres.
I.	2,902·4444
II.	2,902·4508
III.	2,902·4178
IV.	2,902·4331
Mean... ...	2,902·4365

The probable error, however, is only relative to the constants assumed for the tape. After the linear measurements, the azimuth was determined from observations on Polaris, near elongation, and the latitude from the same star near culmination. The longitude was not determined directly, but a provisional value near enough for the computation of the survey was adopted from the $\frac{1}{4000}$ map of the Public Works Ministry by measuring from two known points in the Nile Valley.

The polygons of the triangulation had previously been reduced by the method of least squares, and the whole was made consistent in the manner indicated in Vol. II, p. 159 of the "Account of the Great Trigonometrical Survey of India."

In no case did the additional correction thus necessitated exceed 0″·16 and the method, though avowedly rough and ready, was probably accurate enough for the circumstances of the case. The lengths of the sides were then calculated, and the back and forward azimuths of a chain of sides extending round the whole triangulation were computed. The azimuth of the starting line computed as the last line of the chain did not differ from its observed value by 0·1 second, which gave a valuable check on the accurracy of the computations in the previous part of the work.

Minor Triangulation.—In the meatime the minor triangulation had been proceeding rapidly under the charge of Mr. Lebnan. The number of points occupied was 184, while nineteen inaccessible points such as sheikh's tombs, minarets, etc., were determined by intersection and used as subsidiary stations. The mean and maximum lengths of the sides were 3,000 and 8,933 metres respectively. The total area triangulated was 2,100 square kilometres, and the cost as follows:—

	£E.	Mill.
Salaries of personnel	492	000
Transport of material, instruments, etc.	280	320
Cost of station marks	76	000
Total	848	320

or £E.0.404 per square kilometre.

The average error of closure of the 330 triangles was 6″·6. One of the first effects of the triangulation was to bring to light the need of more careful work in the traversing, especially in measuring the lines, and much time was lost—but not altogether wasted—in waiting for the retraverse of the incorrect lines, seldom many in any one village, it is true, but still sufficient to delay the preparation of the field-maps for the detailed survey.

DAQAHLIA AND QALIUBIA MAJOR TRIANGULATION.

The major triangulation of these Mudirias was carried out in one piece, which took the shape of a long chain of central polygons extending from Cairo in a north-easterly direction to the Damietta mouth of the Nile. The reconnaissance began on the 1st April, 1900, and operations continued till the end of June, 1901. Owing to the number and extent of the palm-groves in the Delta, and the consequent expense that would have been incurred had theodolite stations been built of height sufficient to give clear rays over the trees, it was decided to make use as far as possible of minarets in the chief towns, employing the platforms as observing points and the vanes as signals.

The total area triangulated (including part of Sharqia and Gharbia to enable the chain of triangle to be carried continuously from Qaliubia to Daqahlia) was 2,950 square kilometres, and the cost amounted to—

	£E.	Mill.
Personnel	948	930
Transport and station marks...	340	920
Base-line	120	000
Total	1,409	850

or £E.0.478 per square kilometre.

The angles were observed by Mr. Villiers Stuart with the 25-centimetre theodolite. The number of principal points was forty-one, while four others were intersected but not actually occupied for observation.

The average of the error of closure of the forty-eight triangles was $2''\cdot4$, a result sufficiently satisfactory when one remembers the unstable foothold and cramped positions afforded by the average minaret platform, and, further, the doubtful steadiness of the vanes in a strong wind.

After measuring a provisional base on the light railway from Mansura to Simbellawin, Mr. Villiers Stuart came to Abbassia in June, 1901, to fix definitely the site for the actual base-line, a suitable position for which had been selected on the desert about a hundred yards north of the old Suez road, near the Second Signal Tower. This was connected to the triangulation, the Observatory and the Venus Station, so that good latitude and longitude values were got from the known positions of the latter two points, and in June, 1901, the actual measurement with the Jaderin 50-metre wires, which had recently been received from Stockholm, was begun. The whole was measured from east to west and the west to east four times in each direction with each wire. Simultaneous readings of the temperature of the air and the tension of the wire were taken, though in the reduction the former were discarded as differing apparently from the temperature of the wires themselves, which was deduced from their assumed cœfficient of expansion. The operations lasted ten days and gave as the result for the length of the line, 3,389·732 metres.

On the completion of this work an azimuth was measured by Mr. Wade from the Observatory to the Venus Station. The astronomical elements utilised were therefore :—

Latitude of the Transit Instrument, Abbassia Observatory (from observations by Mr. Wade extending over a period of three months) 30° 4′ 35″·8.

Longitude of Venus Station (from the published results of the 1874 Transit of Venus Party), 31° 16′ 33″·6 E. of Greenwich.

Azimuth of Venus Station at the Observatory (towards the west from the south point of the meridian) 10° 0′ 04″·00.

The eccentric angles had been centred with the help of the provisional base referred to above, and the errors had been adjusted by the method employed for the Fayum, so that in October the latitude and longitude of all the principal stations, with the back and the forward azimuth of all the sides could be computed. The coordinates of the points were then computed and the work was available for checking the minor triangulation.

Minor Triangulation.—This had begun in December, 1900, and was carried out by the parties with the following districts :—

Qaliubia, Party I ;
South Daqahlia, Party II ;
North Daqahlia, Party III ;

At the end of the year the three parties had almost completed their work.

The cost amounted as follows :—

	£E.	Mill.
Party I.—Personnel	314	000
Transport, etc.	161	986
Marks	15	840
Total...	491	826

	£E.	Mill.
Party II.—Personnel	462	000
Transport, etc.	147	294
Marks	25	840
Total...	634	374

	£E.	Mill.
Party III.—Personnel...	285	000
Transport, etc.	178	027
Marks	21	780
Total...	485	807

Further details are given in the attached comparative table :—

MAJOR TRIANGULATIONS.

	Fayum.	Daqahlia-Qaliubia.
Extent in square kilometres	2,077	2,950
Time taken (days)...	293	270
Stations occupied	53	41
Lines observed	133	93
Triangles...	81	48
Average length of side (metres)...	8,700	15,000
Cost (£E.)	703.00	1,289.80
Cost per square kilometre (£E.)	0.339	0.437
Cost per station (£E.)	13.264	31.458
Average error of closure of triangles...	3″·8	2″·4

MINOR TRIANGULATIONS.

	Fayum.	Qaliubia.	South Daqahlia.	North. Dakahlia.
Extent in square kilometres	2,100	830	980	1,120
Time taken (days)	467	404	424	389
Stations occupied	239	186	203	192
Lines observed	654	445	565	495
Triangles	330	300	356	303
Average area (square kilometres)	6·4	2·8	2·7	3·7
Average length of side (metres)	3,000	2,500	2,800	3,600
Cost (£E.)	848.32	491.83	634.37	485.81
Cost per square kilometre (£E.)	0.402	0.592	0.647	0.434
Cost per station (£E.)	3.55	2.65	3.12	2.53
Average error of closure of triangles ...	6″·6	3″·7	4″·8	4″·0

Projection used for Maps.—In 1900 it was decided to employ the Gauss "conform" projection for the maps of the detailed survey, but as the necessary tables were not computed before the autumn when the sixth Taftish was formed to begin work in the Fayum, the map-sheets there were prepared on a polyhedral projection, with a different origin for each village.

In Qaliubia and Daqahlia, however, conform rectangular coordinates were used, with an origin at the point the latitude and longitude of which were 30° N. lat. and 31° E. of Greenwich respectively. As the position of this point depends on the geographical coordinates of the Venus Station on the Mokattam, the latter becomes the virtual origin of coordinates for the triangulation. This projection will in future be employed for the maps of the two mudirias just mentioned as well as for those of the mudirias south of Giza, and it will in addition serve for the maps of Giza and Fayum mudirias on the scales $\frac{1}{10000}$ and $\frac{1}{50000}$.

A system of numeration of the map-sheets, based on those of the scale $\frac{1}{10000}$ as unit, has been adopted, according to which the whole country is first divided into quadrants by the axes, then subdivided into rows by parallels of latitude at distances of 36″ and into columns by meridians at distances of 45″. The position of a sheet is thus denoted by giving (1) the quadrant, (2) its row and (3) its column. The sheets on the scale $\frac{1}{10000}$ are all divided similarly into sixteen cadastral sheets with consecutive numbering from 1 to 16.

The cost of the computation of the triangulation was £.E.350 in 1900 and £E.458 in 1901.

TRAVERSE COMPUTATION.

During the year this section has been occupied with the computation of the traverses in part of Sherbin, and in the markazes of Shebin-el-Kom, Quesna, Sennures, Fayum and Etsa. In the three first, since no triangulation was available for checking the traverse work, the method of reduction was different from that employed for the Fayum. Briefly, it consisted in selecting a large part of the markaz and so adjusting the boundary that it closed accurately. This done, the village boundaries were then adjusted to close, and the same principle was applied to the internal village traverses. There was no guarantee, however, that the corrections applied to common boundaries were justified, and the parts of a markaz left to the end were dependent to a certain extent on the system of adjustment adopted in the localities computed earlier. With a triangulation available where the errors of observation were of a far smaller order than those of the traverse, it became possible so to adjust the latter that there was a reasonable certainty of corrections not far from the true values being applied. Further, as each traverse was adjusted by comparison with the nearest minor triangle side, the corrections became as far as possible independent, and errors were prevented from accumulating.

For the purpose of computation, traverse lines are divided into two classes—main lines which run as nearly as possible in a straight line from one triangulation point to the next, and secondary, which form the lines between the former and each other. The main lines are adjusted to consistency with the triangle sides, and then the secondary are corrected so as to close accurately on the others. The corrected azimuth (α) of each line in a traverse having been calculated, the length (s) is muliplied by Cos α and Sin α to get the increments of the co-ordinates of its end point. The actual multiplication is performed on Brunsviga computing machines of which seven are now in constant use. The advantages of using this machine in preference to working logarithmic tables are (1) rapidity, (2) a gain in accuracy, (3) a greater output in the work. When logarithms are employed the tables have to be opened at four places, necessarily far apart viz., to get the logarithm of the length of the side, those of the angular functions, and those of the products, whereas with the Brunsviga only one opening of the book is necessary. There is thus a lessening of the time consumed at this stage and a diminution by three-quarters of the risk of error in looking up the wrong logarithm. There is a further gain in accuracy in that the arithmetical part is purely mechanical and involves no more brain-work than is involved in turning a handle and reading a row of digits. The computers are able to continue work for six or seven hours a day against the four or five usually expected when tables alone are used. It is found that on the average fourteen points (i.e. twenty-eight multiplications with all the necessary checkings and re-computations) can be done per hour by one computer working with the Brunsviga machine. A total of about 43,000 points were computed and checked at a cost of £E.560.

After computation of the increments of the co-ordinates, the total Northing or Southing and Easting or Westing from one triangulation point to another by a traverse route are calculated and adjusted to the values found from the minor triangulation, and a similar process is applied to the secondary or tie traverses. It is at this point that the greatest delay has hitherto occurred from the necessity of re-traversing lines where errors inadmissibly large have shown that grave carelessness has been exercised either in chaining or in booking the lengths.

The co-ordinates of the points having been calculated, the latter are then plotted on the field sheets, which, after the traverse lines have been checked, are issued as skeleton maps to the Taftishes.

This plotting is done by means of co-ordinatograph, a machine made by Coradi, of Zürich, by means of which points can be quickly and accurately plotted. As many as twenty-five to thirty points per hour can be easily plotted by means of it with an accuracy of one-tenth of a millimetre in their relative positions: 2,390 sheets were plotted with it during the year at a cost of £E.175.

The size of the map-sheets up to the present has been 45 x 45 centimetres, which, on a scale of $\frac{1}{2500}$, represents a square of 1,125 metres in length and breadth or just over 300 feddans. Early in the year the question of allowing for the unavoidable shrinkage of the map-sheets after they had been plotted was discussed, and a table issued to the taftishes to enable correction to be made with a minimum of labour. The matter is one of very considerable importance, as will be shown, and in view of this, experiments with other classes of paper are being made to see if the shrinkage is absolutely unavoidable. From measurements of some sheets of Gharbia it was found that the average reduction in area per sheet was almost exactly 3 feddans or 1%. But assuming that this is excessive and that 2 feddans per sheet is about the usual amount, this represents in the Fayum alone a loss of some 3,300 feddans of taxable land, which at an average tax of 100 P.T. the feddan would mean a direct loss to the Revenue of £E.3300 *per annum*, from one mudiria alone. In some few instances where the maps have been plotted in exceptionally dry weather, an increase in size has been found, but these cases are so infrequent that their effect on the above figures may be neglected.

The office was further occupied during 1901 with the computations for the Sudan Almanac issued by the War Office, the Gregorian Calendar, the Imsakia or special calendar for the month of Ramadan, and the Natiga or Mahomedan Calendar all issued by the National Printing Department.

The necessary computations for the new official almanac were also undertaken, and much of the information compiled in the office.

Theodolite traversing.

The first four months of the year the staff engaged in traversing with the theodolite were at work in Menufia and especially in the Fayum completing villages in these Merkazes, but after April 6 work was commenced in Qaliubia and Daqahlia. The work, however, proceeded but slowly, since constant re-traversing and correction in the Fayum were necessitated by the repeated removal of survey marks as has already been described (v. supra). Normally, the traverser runs a traverse from one point of the minor triangulation to another, the points being not more than 500 metres or less than 100 metres apart. The angles are read (both face right and face left) with a 5″ theodolite, and the distances are measured twice with a chain. Secondary traverses are run from the points thus fixed so as to furnish a traverse along the village boundary and as many cross-traverses as may be necessary for the chain survey of the village.

In the Fayum and in Qaliubia and Daqahlia sixteen points are fixed per square kilometre, an increase on what was usual three years ago when 3·7 were considered sufficient. This number (sixteen) is less than that used in Europe where a similar system is in use, but in Egypt, where there are no hedges, few enclosures, and all the country is practically on the same level, it seems to be sufficient. The cost of the staff which was working in Qaliubia and Daqahlia for 8½ months was as follows:—

	£E.
Salaries of traversers, chainmen, etc.	666
Travelling and other expenses	105
Freight and cost of stone marks	97
Total	£E.868

For this sum there were traversed—

	Feddans.	Points traversed.	Lines chained.
Qaliubia...	40,865	2,866	685
Daqahlia	52,774	3,444	911
	93,639	6,210	1,596

That is 394 square kilometres or 16 points and 4 kilometres of chainage per square kilometre.

The cost per square kilometre = £E.2.200, to which something has to be added for subsequent correction of re-traversing of errors, but the amount of this is not easily determinable as it varies widely in each village, being dependent not only on the care of the observer but also on the removal of the marks.

The experiment of using small angle-irons driven well into the ground is being tried, as they are less conspicuous than stones and more easily identified as bearing the Government stamp; the earthenware drain pipes, much used in Europe for marking traverse points, would be too useful in the irrigation of their fields for the fellahin to leave them long in place.

The average rate of traverse work has been seven points observed and 1,660 metres chained per diem, including the days spent in putting down marks determining boundaries, making up lists, etc., for a full working day spent in actual traversing the rate is on the average ten points and 3,000 metres per diem.

Detail Survey.

The Revenue Survey was carried out mostly in the provinces of Menufia and Fayum, though there was a certain amount of work done to complete other provinces surveyed in the previous year.

The very large area in Sherbin includes areas of waste land in the north of the Delta which could not be surveyed during the winter months as they were not dry enough.

The following table shows this in detail.

As it is impossible to say exactly what proportion of work belongs to 1901, of that which was begun in 1900 and finished in 1901 or which was begun in 1901 and finished in 1902, the areas of such villages are given in the table under separate columns. The work in Tanta, Kafr el Zayat, Mehallet el Kobra, and Zifta merkazes was revision of work previously done, and had been returned in order to be brought up to date.

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MERKAZ.	1900-1901	1901	1901-1902	Total.
	Feddans.	Feddans.	Feddans.	Feddans.
Tanta	—	30,219	—	30,219
Kafr el Zayat	—	5,014	—	5,014
Mehallet el Kobra	—	49,622	—	49,622
Zifta	—	53,793	—	53,793
Sherbin...	—	297,230	—	297,230
Borollos...	—	36,801	—	36,801
Tala	32,598	20,695	—	53,293
Shibin el Kom	—	14,013	28,928	42,941
Menuf	11,625	3,185	60,465	75,275
Quesna	2,474	13,125	32,687	48,286
Ashmun...	17,197	—	—	17,197
Embaba...	54,156	—	—	54,156
Giza	7,241	—	—	7,241
Saff	16,956	—	—	16,956
Sennuris	17,563	1,889	90,489	109,941
Fayum	—	8,948	60,824	69,772
Etsa	—	36,337	103,182	139,519
	159,810	570,571	376,575	1,107,276

The Revenue Survey is specially in charge of Mr. Humphreys, and to him is largely due this satisfactory result. The Inspectors of Taftishes have all improved both the quality and the rate of work, though they have many difficulties to contend with in keeping up to the rapid rate now required by the Finance Ministry.

The rate of work per 100 feddans as deduced from the villages actually begun and finished in the twelve months is slower than that given in last year's report. This is due to the very much closer country surveyed in Menufia and to the difficulties met with in the Fayum. Some of these have been indicated already, but what has mostly made the field-work slow is the irregular form of the holdings and also the deep ravines which cut up the province and in which are situated cultivated lands.

The proportion of time spent in field-work to that in the preparation is much the same as last year though the actual time is greater.

The cost of work can only be satisfactorily arrived at from a considerable number of villages, since many causes may raise or lower the cost in special cases; the waste lands in the north of the Delta (Burollos and some of Sherbin) give low values, while some close villages of Fayum with irregular boundaries largely increase the expense, as also does the employment of newly trained surveyors who at first work slowly.

The following table gives the rate of work and the cost of work for certain villages in thirteen merkazes for which accurate data are available.

TIME AND COST OF REVENUE SURVEY PER 100 FEDDANS.

MARKAZ.	Number of villages.	Area in feddans.	Days per 100 feddans		Cost per 100 feddans.			
			Field-work.	Records.	Field-work.		Records.	
					£E.	Mill.	£E.	Mill.
Etsa (begun and completed in 1901)	20	36,337	6·22	3·12	1	231	—	352
Fayum (begun and completed in 1901)	5	8,949	8·78	4·10	3	800	1	173
Sanures (begun and completed in 1901)	10	19,397	7·92	6·51	1	797	—	910
Shibin el Kom (begun and completed in 1901)	19	14,010	7·74	9·58	1	986	1	616
Menuf (begun and completed in 1901)	21	14.938	7·00	8·56	1	567	2	162
Quesna (begun and completed in 1901)	22	15,454	11·05	10·00	2	551	1	600
Ashmun (begun 1900 and completed in 1901)	6	17,179	4·89	9·45	1	167	1	476
Tala (begun March, 1900 and completed in 1901)	24	32,792	4·26	6·82	1	186	2	178
Embaba (begun 1900 and completed in 1901)	10	27,998	2·26	3·46	—	670	1	121
Giza (begun 1900 and completed in 1901)	2	2,245	4·14	4·54	1	275	1	756
Saff (begun December, 1900 and completed in 1901) ...	10	17,019	4·54	5·14	—	890	—	544
Burollos (begun and completed in 1901)	2	36,801	0·72	0·09	—	180	—	015
Serbin (begun 1900, and completed in 1901)...	6	297,667	1·30	0·31	—	262	—	100
Mean...			5·45	5·51	1	428	1	154

Method of work.

The map-sheets with the fixed points plotted on them are issued to the surveyors, who fill in the detail on the ground. The rate of work necessary will not allow of this being entered up in a field-book by one surveyor and then plotted independently by another. The same man chains up the detail and plots it on the field-sheet. For the same reason all areas are calculated graphically on the sheets instead of being computed from the measured dimensions. When the detail has been surveyed and drawn on the map, special employés calculate out the areas by means of a computing scale, which is especially divided to give the result in feddans, qirats and sahms. This is done twice independently, and the results then compared by a senior employé by whom discrepancies are examined. Besides this, each subdivision (Hod) is measured on the map with a planimeter, and this result should equal the sum of the areas of the plots in the Hod.

Similarly, the sum of the areas of the Hods is compared with the total area of the village, which is computed from the theodolite traverse and is furnished by the Central Office.

The principal difficulties are that proprietors frequently do not attend to point out their lands, and consequently they are wrongly surveyed; also that some proprietors have encroached on the land of others and each maintains the land is his. Existing registers only show the total of each man's land in a village, but give few or no indications as to where it is located. Now, besides posting a notice of survey in the village, a notice is sent by post to every non-resident proprietor whose address can be ascertained. As soon as the village has been mapped and the registers are completed, the result is read out in the village and a slip is given to every landowner showing the result of the survey for his lands, and notifying him that any complaint will be examined if presented within thirty days, after which interval the fair copies of the registers are made and sent to the Finance Ministry.

This last notification has only been recently introduced; it has increased somewhat the work of the survey but should reduce errors and subsequent complaints. Every effort is being made to obtain correct results, but the indifference of the landowners often renders it no easy matter.

The cultivated land in Egypt is much subdivided, especially in the most fertile parts. The following table gives an idea of the subdivision in the provinces of Giza, Menufia and Fayum. The most marked feature is the long narrow fields, which are well shown in the Lahun village where they are of exceptional length.

The following table shows for certain merkazes the percentage of holdings under 12 qirats (2,100 square metres) and under 5 feddans (21,000 square metres), but for many of these two and three or even more names of proprietors have to be recorded.

AVERAGE SIZE OF PLOT.

MARKAZ.	Number of villages.	Total Number of plots.	Plots under 12 qirats.	Percentage.	Plots under 5 feddans and over 12 qirats.	Percentage.	Plots over 5 feddans.	Percentage.
Etsa	20	18,467	8,035	43·4	9,497	51·5	935	5·1
Fayum	5	5,878	3,162	53·7	2,495	42·4	221	3·9
Sanures	10	9,270	4,422	47·8	4,347	47·0	501	5·2
Shibin el Kom... ...	19	12,326	5,328	43·2	6,739	54·8	259	2·0
Menuf	21	13,754	5,594	40·6	7,892	57·3	268	2·1
Quesna	22	9,640	3,041	31·5	5,768	59·9	831	8·6
Ashmun	32	31,362	11,233	35·8	19,049	60·7	1,080	3·5
Tala	55	53,767	18,965	35·2	32,515	60·5	2,287	4·3
Embaba	35	32,891	9,852	30·0	20,758	63·1	2,267	6·9
Giza	25	12,765	3,546	27·8	7,141	55·9	2,078	16·3
Ayat	17	15,385	7,356	47·8	7,199	46·8	830	5·4
Saff	26	20,868	6,803	32·6	12,925	61·9	1,140	5·5
Burollos	2	86	19	22·1	44	51·2	23	26·7
Sherbin	6	6,413	865	13·4	3,020	47·0	2,528	39·6

The Drawing Office has printed during the year 1901 a considerable number of maps as well as plans, plates for reports, etc., showing an increase on the previous year. Registers and forms needed for the Revenue Survey are also lithographed in large numbers.

However, neither the amount of work done nor the quality of the fair drawing were up to the requirements of the Department. Almost all the European draughtsmen obtainable in Egypt have been trained in Architectural drawing and have very little knowledge of map-drawing, while Egyptian draughtsmen have usually but an elementary acquaintance with either. To improve this Mr. Wiltshire, who had eighteen years' experience as a draughtsman in the Ordnance Survey Office at Southampton, was put in charge of a small staff consisting mainly of young Egyptian employés who had a slight knowledge of drawing.

During the year great improvement was made both in the quality of the work and in rapidity of execution.

The fair drawings of all maps and such compilation as is necessary for topographical maps, plans for reports, etc., are now made in this office, and these fair drawings are furnished to the litographic office for reproduction which has given much better results than when the whole work was done in one office.

Mr. R. M. Hansard joined the Department in December and took over charge of the drawing and reproduction work, as H. Ravon Bey was absent through illness a considerable part of the winter.

At the end of the year the drawing and reproduction staff consisted of:—

	Europeans.	Egyptians.	Total.
Lithographic draughtsmen	9	2	11
Draughtsmen on village maps (autography)...	—	20	20
Topographic draughtsmen	4	17	21
Lithographic printers	4	—	4
Assistant printers	—	15	15
	17	54	71

At present it appears almost impossible to obtain Egyptians as good lithographic draughtsmen, engravers, or head printers.

Those who can be employed as assistant printers have seldom the necessary education to become good head printers.

The reproduction of the village maps by autography is done by Egyptian draughtsmen, but there are few of them at present who are competent to draw fine work or to engrave on stone.

When the maps of the Revenue Survey are received from the Inspectors in charge of the field Survey Taftishes, they are passed to the Drawing Office for reproduction. This is done by autography, a tracing being made in lithographic ink on transfer tracing paper and then transferred to zinc in the ordinary way.

The average cost of these maps per sheet, 45 centimetres square, is at present:—

	£E.	Mill.
Cost of drawing and writing	1	512
Cost of drawing and printing 48 copies	0	213
Total	1	725

The actual cost of reproduction (about 34 milliemes per copy) would be much lower if a larger edition were printed, but it is at present more economical to keep the zinc sheet.

The time taken to print an average village sheet is—

Drawing and writing	11 hours
Printing, etc.	1 ,,
	12 hours

Besides the above work there is a large amount of tracing done on repayment for landowners in Behera, Sharqia and Gharbia, the maps of which were never printed; 591,550 feddans were traced during the last six months of the year at a charge of £E.252.157.

During the same period 155,265 feddans were traced free of charge for the Ministry and for the Irrigation Circles.

The number of maps printed and published during the year together with the plans, diagrams, etc., was :—

	Maps.		Plans, diagrams, survey forms, etc.	
	No. of maps.	No. of copies.	No. of plans.	No. of copies.
1900	840	38,025	34	19,250
1901	1,155	31,809	176	111,000

Topographical Maps.

As soon as the staff necessary for the Revenue Survey had been organised and trained so that a sufficient area could be dealt with annually, the very urgent matter of Topographical Maps for the Irrigation Service and also for other Government Departments could be taken in hand.

Hitherto the only printed maps have been those of the various provinces on a scale of $\frac{1}{1000000}$, except Gharbia, Menufia, and Qaliubia for which no maps existed.

The provinces of the Delta were triangulated and surveyed with the planetable between 1892 and 1897, but almost all the triangulation marks have been removed and lost. As a temporary expedient, until such time as a new triangulation can be carried out, it has seemed best to prepare a provisional map which, though not absolutely accurate, would contain no error large enough to be detected in any group of six or eight sheets. The original field-sheets of the older survey have therefore been revised in the field and brought up to date in detail. These revised sheets have then been fitted together, corrected to the true meridian (since the old triangulation had been calculated on a magnetic meridian), and lithographed.

The staff consisted of six young Egyptian surveyors trained in the Department, and under the supervision of Mr. E. M. Dowson they have turned out very satisfactory work.

At first progress was necessarily slow, but it quickly improved, and by the end of the year, i.e. in less than five months, thirty-four sheets containing 25 square kilometres had been revised.

These included the town of Damanhur and the country between it and the Nile.

Owing to the original map-sheets having been oriented to the Magnetic North it was necessary to redraw the work before the sheets were ready for reproduction, which was done so as to give maps of 60 centimetres by 40 centimetres on a scale of $\frac{1}{10000}$, thus each map containing 24 square kilometres.

These maps are then transferred to stone by autography and printed in black, with the main drains in green and all other water-courses in blue.

The difficulty of obtaining good European writing on the maps owing to the want of skilled writers, and to the fact that the photography could not be employed since the photographic office is not yet ready, has prevented these maps from being published in English and Arabic as was intended, but as they were urgently required they have been printed and issued in Arabic only for the present, but a second edition will shortly be issued in both languages.

As soon as sufficient sheets on $\frac{1}{10000}$ are ready, the publication of $\frac{1}{50000}$ maps will be commenced, of which an English and an Arabic edition will be printed.

The cost at present has been as follows:—

	£E.	Mill.
Surveyors' salaries	199	000
Travelling and other expenses	55	000
Total for 850 square kilometres	£E.254	000

or £E.0.300 per square kilometre.

The cost of fair drawing and lithographing was as follows:—

For 275 copies of a sheet containing 24 square kilometres.

	£E.	Mill.
Average cost of drawing	2	200
„ „ of lithographing	3	150
„ „ of printing, including paper	6	160
Total...	£E.11	510

or 40.5 milliemes per copy printed.

Cost of field revision of 24 square kilometres...	7	200
Total cost per sheet...	£E.18	710

About 280 sheets will be necessary to complete the whole province of Behera.

The time taken at present per sheet is:—

Compiling and fair drawing	7½ days.
Lithographing	50 hours.

Observatory.

The Abbassia Observatory has worked throughout the year on the lines of the new organisation which was worked out during 1900. There have been some changes among the observers and Mansur Bey Sidky took up work at the Observatory in February and acted as assistant to the Superintendent.

The work of installing and regulating the self-registering instruments having been completed, Mr. E. B. H. Wade, the Superintendent, has been able to resume the magnetic observations at Helwan which had been interrupted for six months. A complete set has been taken weekly. Observations on atmospheric electricity were commenced and are now being made regularly. The Observatory is now equipped to register automatically all the meteorological elements, as well as Earth Tremors. Detailed descriptions of the instruments and of the methods of observation and reduction are given in the annual meteorological Report of the Department.

The Standard Sidereal Clock was sent to London for cleaning, and to be fitted with electric contacts, and time signals are now transmitted daily to Port-Said, Alexandria, the Citadel, Cairo, and Wadi-Halfa.

During the year the three-hourly observations for the years 1898 and 1899 were published together with the mean values of the fifteen years 1869-1873, and 1874-1898. This completes the publication of the old series of observations. Those for 1900 taken hourly are now in the press and will be shortly published.

The meteorological stations which were working in 1900 were maintained, and by an arrangement with the War Department several Sudan stations were equipped with apparatus, the observations being taken by an officer at the station. At the end of the year all these stations were visited by one of the Observatory Staff, Mansur Bey Sidki, who verified all the instruments and equipped some new stations.

Abbassia Observatory (near Cairo) 1st Order Station.
Alexandria.
Port-Said.
Barrage.
Beni-Suef.
Assiut.
Aswan.

Sudan.

Wadi Halfa.	Dûem (on White Nile).
Berber.	Wad Medani (on Blue Nile).
Khartum.	Suakin.

Adis Ababa (Abyssinia).

Rainfall only.

Fashoda.
Roseires.
Kassala.

Telegraphic weather reports are sent daily from each of the above stations, except Adis Ababa and the Rainfall Stations, and from them a daily weather report is published.

At the end of the year the daily telegrams which had been sent from Beirut by the kindness of the Rev. H. H. West of the Protestant College, were discontinued. In consequence of the irregularities of the Turkish Telegraphs the telegrams frequently arrived too late to be of use, and the cost of them was very heavy since the Ottoman Government would allow no free messages.

Proposals have been made to exchange daily weather telegrams between Alexandria and Cyprus, which the Eastern Telegraph Company have kindly agreed to transit free of charge.

The Public Works Department of Cyprus have informed this Department that arrangements are being made to take the necessary observations.

The observations of all except rainfall stations are published in full monthly, and 110 copies are distributed to Government Departments, foreign observatories and weather services, while abstracts of them and the rainfall observations are published in the Annual Meteorological Report.

An Annual report containing the observations made at Abbassia Observatory during 1898 and 1899 has been published, and the mean values for the thirty years ending 1898 were given in it arranged for two periods of fifteen years.

The Report for 1900 is in the press.

In the Spring, tentative forecasts were issued when any noteworthy change in the weather conditions was indicated, and from 1st November these were introduced regularly into the Daily Weather Report with the results shown in the appended table.

Number of forecasts issued	51
Percentage of successes in Wind Direction...	75%
„ „ „ Force	89%
„ „ Temperature	86%

The meteorological element that appears most difficult to forecast here is, as might be expected from experience in other countries, rain. For forecasting purposes Lower Egypt is divided into two districts, North Delta, and Cairo and neighbourhood. Weather prediction in Egypt labours under the disadvantage that there are no neighbouring stations to the westward from which most of the storms seem to come, so that a storm sometimes breaks before there is time to forward the warning to the coasts. It is hoped, however, that increased experience and knowledge acquired when the special problems of Egyptian meteorology are worked out will enable this branch to send forecasts that will be of value to shipping in the E. Mediterranean. It appears further from a study of the Daily Weather Reports that changes in the meteorological conditions over the Mediterranean rarely make themselves felt beyond Aswan, and that the Meteorology of the Sudan may be worked out independently of that of Egypt proper.

Geological Survey.

Two of the Geologists, Mr. Beadnell and Dr. Hume, were employed on the Geological Survey of the Fayum and the 2nd Cataract respectively, while Mr. Barron was mostly engaged in the transfer of the collection to the new Geological Museum which was handed over to the Department in June. By December considerable progress had been made with the arrangement of the collection, and the remainder of the winter he was engaged in surveying the desert between Cairo and Suez. Dr. Hume's work at the 2nd and 3rd Cataracts consisted in a detailed examination and survey, similar to that which had been done previously by Dr. Ball at the 1st Cataract. Mr. Beadnell's work round the Fayum has resulted in finds of the highest scientific interest. He had in 1899 already found bones of vertebrata in the Western Desert, near the Fayum, and in the spring of 1901 he visited the localities again in company with Dr. A. C. Andrews, of the British Museum, who was on leave in Egypt. This visit resulted in the discovery of bones of considerable importance, and further work in and near the same locality produced the remains of a rich and, for the most part, totally new fauna from the Upper Eocene Strata. These were sent to the British Museum for determination, and preliminary descriptions have been published by Dr. Andrews. In November, Mr. Beadnell continued work in and near the same locality and was rewarded by finding a magnificent series of fossil animals in extremely fine condition. In spite of the friable state of the bones, and the distance they have to be transported, numerous very fine specimens have already been safely deposited at the Museum for examination and description.

Reports on Kharga, Farafra, and Daqhla Oasis were published during the year.

Also Reports on the—

Building Stones of Cairo,
Geology of Baharia Oasis,
Geology of the Eastern Desert,
Geology of Abu Roash,
Geology of Kurkur Oasis,

are in the press, and there are besides in preparation others on—

The Peninsula of Sinai,
The Fayum,
The Nile Valley.

Chemical Laboratory.

The Chemical Laboratory under Mr. A. Lucas has carried out a large amount of analytical work, together with a report on the action of salts on building stones which is ready for printing.

In 1901, 342 analyses were made against 246 in in the previous year:—

Table I.

From		Number of samples analysed.	
		1900.	1901.
Public Works Ministry.	Survey Department	101	224
	Tanzim Department	63	80
	Irrigation Department	4	32
	Department of Antiquities	9	5
Ministry of Interior, Prisons Department		—	1
Finance Ministry		69	—
		246	342

Table II.

Nature of sample.	Number of samples analysed.
Geological specimens (ores, etc.)	22
Building stones	71
Building materials other than building stones	93
Soils	68
Water	79
Miscellaneous	9
	342

At the end of the year the standard measures of length and weight were placed in a room at Giza, which will be fitted up for the verification of such weights and measures as may be sent. A stone-crushing machine, already ordered, will also be erected there, so that such physical tests and measurements as are required by the Public Works Ministry may be carried out there.

Railway Survey.

During the first three months of the year a line of survey including levels was run from Korosko to No. 6 Station on the Wadi Halfa-Abu Hamed line.

H. G. LYONS.

9th April, 1902.

	Survey.		Computing Office.		Drawing Office.		Central Office Staff.		Observatory.		Geology.		Laboratory.			
	No.	£E.	No.	£E.	No.	£E.	No.	£E.	No.	£E.	No.	£E.	No.	£E.	No.	£E.
Inspectors	9	3,014	2	684	3	1,458	—	—	1	360	—	—	—	—	16	5,516
Senior employés	55	5,062	—	—	2	42	10	1,276	—	—	—	—	—	—	67	6,680
Junior employés	240	7,778	43	972	60	3,330	37	1,705	2	132	—	—	—	—	382	13,917
Hors cadre...	310	5,395	—	—	—	—	34	601	8	202	—	—	2	34	354	6,232
															819	32,345

SPECIAL CREDITS.

Inspectors	2	535	—	—	—	—	—	—	—	—	2	946	1	300	4	1,781
Senior employés	2	321	1	74	1	498	—	—	1	165	1	110	—	—	6	868
Junior employés	2	21	—	—	5	408	2	30	—	—	—	—	—	—	9	459
Hors cadre...	11	26	—	—	—	—	—	—	—	—	3	43	—	—	14	69
															33	3,177

REPORT ON THE TECHNICAL DEPARTMENT

1901

BY

Md. ANIS Bey,

CHIEF OF TECHNICAL DEPARTMENT.

TECHNICAL DEPARTMENT.

YEARLY REPORT, 1901.

Steam Engine Service.

The work of this Service was carried out during the year 1901 in accordance with the Steam Engine Regulations issued on the 5th of November, 1900. The effect and working of this Layha has proved very satisfactory. It has removed most of the difficulties under which the Service was labouring and has enabled it to act with more independence, and without that constant reference to the Contentieux which previously caused so much hinderance and delay.

Articles I-III of the Decree have finally settled the question of Registration, and Art. IV settled the question of Inspection.

Paragraph 3 of Art. III provided that all engine proprietors who had not a Rokhsa, or had not previously declared the existence of their establishments in accordance with the old regulations of 1896, should report or declare their existence to the Ministry within the period of sixty days from the date of issue of the new regulations. Engines thus declared would be considered as having Rokhsas, and become subject to the new inspection rules. Those that remained undeclared would be treated as newly established without Rokhsas and their owners dealt with accordingly. Many of the latter having lost the opportunity thus offered them, and not wishing to be put in court, came to the Service for Rokhsas, and the Service was glad to give them every assistance consistent with its regulations. Thus the demands for Rokhsas during the year 1901 came to 323 as against 153 in 1900. This together with forty-three remaining under consideration from the year before, and thirty-six received from the Mudiriehs for using pumping engines for industrial purposes, make a total of 402.

Of this number, 336 were granted and sixty-six remain under consideration.

Of the 336 receiving Rokhsas, 235 made application for test, were tested, and proving satisfactory were given their certificates and allowed to work.

Up to the 5th of November, 1900, the date of issue of the Layha, only 614 establishments were considered registered and in order by the terms of the new law; since then twenty more have been added by the Contentieux, being considered by them as declared and also in conformity with the law, which with the 235 sanctioned for work during the year, make a total of 869 industrial engines working in conformity with the law up to the end of November, 1901.

Many of the existing old engines, declared or undeclared, not being in order, steps had to be taken to force their owners to comply with the present regulations. For this it was found necessary to inspect and report on their engines before legal proceedings could be taken. 681 such visits of inspection were made; and 235 visits were made for testing the engines sanctioned during the year, this makes the total number of inspections 896.

I have here to remark that it was previously noticed that a great deal of time and money were unnecessarily spent in sending engineers to test boilers which were not ready, although demands by the owners had been made asking for test, and stating at the same time that everything was done in accordance with the regulations of the Service. Something had to be done to prevent this abuse, and Art. 7 was put in the new law, which made the Government liable for the expenses of the first visit only, any extra visit to be paid for by the engine owner. This had the desired effect, as very few of those trivial demands were received during the year.

As regards contraventions, I am glad to say we have, also, been fairly successful, as we have, up to the present, gained most of our cases in both Native and Mixed Courts.

To prevent the delay and annoyance formerly caused by outside experts appointed by the Courts to enquire into technical points in opposition to our inspectors, a Decree giving the Inspectors the right to appear before the Courts as *Police Judiciaire* was issued on the 13th of April, 1901. Since the issue of this Decree twenty-eight engine owners have been prosecuted before the Native Courts and ten before the Mixed Tribunals.

In the Native Courts eight were sentenced to stop their engines, five were fined, and fifteen are still in Court.

In the Mixed Tribunals, four were sentenced to stop their engines, two were fined, one was acquitted, and three are still in Court.

During the year one boiler exploded at Atfeh, in the Behera Province. This boiler was unauthorised and the Inspector had no knowledge of its existence. From enquiry it was found that the boiler was out of work for nearly ten years and suddenly put into work a few days only before the explosion. It is also found that on the night of the accident the driver left the boiler well lighted and went to sleep. Fortunately, no casualties happened, as no person was near the place at the time.

At Messrs. Planta's Factory a steam pipe burst at the flange and killed three men. They were sleeping on the top of the boiler, and could not get away before the steam and water scalded them to death.

The great amount of work so suddenly thrown on the Service by the introduction of the new law was soon found to be more than Mr. Crawley and his staff, in spite of all their energy, could manage, and two engineers had to be added, both being paid from the Arsenal economies. One of these engineers was proposed for permanent employment and put on the budget for 1902 at the pay of £E.240 a year. Mr. Crawley, the Inspector of Steam Engines, was, on the 1st of November, promoted to the place of the late Sidky Bey as Director of Works. He is, however, still acting as Inspector of Steam Engines, as no one is yet appointed in his place. He worked very hard, and was constantly travelling from place to place, and I am glad to say that great praise is due to him and his staff for bringing the Service to its present state of efficiency.

Irrigation fixed engines.

Twenty-three Rokhsas for irrigation fixed engines were delivered from the Technical Service during the year. These with 766 Rokhsas in hand before, make the total number of Rokhsas in hand 789. Their distribution among the different irrigation Circles is as follows:—

	Exchanged in 1901.	Given in 1901.	Effective at the end of 1900.	Effective at the end of 1901.
1st Circle	2	7	209	216
2nd Circle	3	9	300	309
3rd Circle	1	3	99	102
4th Circle	0	1	129	130
5th Circle	3	3	20	23
Girga Directorate ...	0	0	9	9
	9	23	766	789

The fees received from the twenty-three Rokhsas given this year were £E.182.

Quarries Service.

The Rokhsas for quarries (in Cairo and its vicinity) given by this Service to the end of 1900 were 638—138 old Rokhsas given for life and 500 new Roksas given for a period of ten years.

Of these, forty-eight are cancelled during 1901, six from the former, by exchange, and forty-two from the latter, thirty-eight by expiration of time, three by exchange and one for contravention.

The number of new Rokhsas given this year is thirty-seven.

The total number now in hand will thus be:—

Old Rokhsas given for life (138–6)	= 132
New Rokhsas given for 10 years (500 – 42 + 37)	= 495
Total...	627

The fees received for the thirty-seven new Rokhsas were £E.617,550.

Central Stores.

I.—ARTICLES PURCHASED OR MADE.

(A) *Instruments and camp equipments.*

		£E.	Mill.	£E.	Mill.	£E.	Mill.
Purchased from Europe	England	437	590				
	France	59	227				
				496	817		
Made by Govt. Services	War Office (tents)...	178	460				
	Sanitary Dept. ...	13	000				
	Arsenal	28	597				
				220	057		
Purchased in the country				510	295		
						1,227	169

(B) *Furniture.*

	£E.	Mill.	£E.	Mill.
Furniture made at the Arsenal.	76	191		
„ in Ghizeh-Ghezireh Pumping Station	48	285		
„ purchased in Egypt	222	208		
			346	684
			1,573	853

II.—REPAIRS TO INSTRUMENTS.

	£E.	Mill.
Repairs made at the Arsenal...	408	813
	1,982	666

III.—ARTICLES SOLD.

	£E.	Mill.	£E.	Mill.
To the Survey Department	3	248		
To the Reservoirs Department	15	900		
To Guirga Directorate	8	550		
			27	698

IV.—ORDERS GIVEN TO THE STORES.

		£E.	
For issue of articles	to Government Services	245	
	sold	3	
			248 —
For receipt of articles	returned	116	
	purchased	73	
			189 —

The value of the articles delivered from the Stores was £E.1,977 distributed as follows:—

	£E.
Irrigation Department	786
Building and Tanzim	379
Administrative Service...	474
Technical Service...	6
Antiquity Service...	140
Survey Department	96
Reservoir Service	96
Total	£E.1,977

Arsenal and Boats.

The work executed in the Arsenal workshops, and the materials delivered from its stores, during the year 1901, amounted in value to £E.30,474. This amount was distributed as follows:—

	£E.
Value of work done for different branches of P. W. D.	24,275
,, ,, other Government Departments	3,313
,, ,, private individuals...	205
	27,796
Value of coals, oil, etc., for steamers	2,678
Total...	£E.30,471

The sum charged to the different branches of the Ministry of Public Works was divided as follows:—

	£E.
To Irrigation Service	15,576
To Reservoirs	528
To Building and Tanzim Service	2,721
To Survey Department	796
To Administrative Service, etc.	534
To Technical Service for repairs to steamers and maintenance of floating and Arsenal plants...	4,123
Total...	£E.24,278

The distribution and cost of the work supplied to the other Government Departments are shown in the following statement:—

	£E.	Mill.
Ministry of Justice: New Native Courts	1,488	161
,, of Finance	641	058
,, of Interior	279	847
,, of Public Instruction	137	445
Sudan Government	129	735
Mudiriehs, Governorates, and Town Councils	493	674
Sanitary Service	62	483
Railway Administration	52	500
Wady Tulimat	27	586
Domains	0	748
Total...	£E.3,313	239

(*a*) 516·5 tons of steel pipes were supplied this year to the Irrigation Services at the total cost of £E.8,131.234, including £E.297.736 for transport and in some cases erection in place. The rate per ton came to £E.15.7 as against £E.17.6 the year before. This economy is due partly to the reduction in price of materials and coals towards the latter end of the year, and partly to the reduction of labour caused by the introduction of hydraulic rivetting and other new machinery. (The average price paid for steel plates being about £E.10 in January and February, and about £E.8.50 in November and December; coals were bought at £E.1.90 per ton in March and £E.1.40 in November). These machines not only effected economy, but also prevented delay in delivery, and greatly improved the quality of the work;

(*b*) 205 tons of cast-iron grooves for £E.2,226.102, including transport and materials for connection;

(*c*) 3,302 pieces of regulating timbers for £E.2,453.953;

(*d*) One house boat, five rowing boats, and one lighter for £E.501;

(*e*) Also some cast-iron piles and sundry other work which cost £E.2,263.711.

The work for the Building and Tanzim Service consisted, as usual, of making and repairing carts, the rates being the same as mentioned in my last year's report.

The Survey Department, and the other Services of the Ministry were mainly supplied with instrument repairs and office furniture and fittings.

To meet the great demand on the Arsenal, especially for ironwork, and to ensure early delivery with good workmanship, it was found necessary to increase the plant by the following machines:

One hydraulic rivetter with accumulator and pump complete, one steam shearing and punching machine, and one angle iron bending machine in smith's shop; one twist drill grinder and one grinding stone in the fitting shop; and one double roller girder over-head crane erected in the foundry.

Besides the above, a new crane was made in the Arsenal for use in the fittting shop, a new furnace was built in the smith's shop for heating angle irons for the new bending machine, and an old crane, taken out of the store, was repaired and erected in the yard, for loading railway trucks. All the old plant was overhauled, the shop engine and some of the shop machine tools were repaired, a part of the old corrugated roof left from last year was renewed, and a new awning for the men was made.

For the floating plant, the dredger and some of the rowing boats were repaired, and a few rooms, found necessary for storage and other use to the steamers, were built in the yard.

The total cost of the above came to £E.1,980. £E.1,429 was paid from the Arsenal economies and £E.551 was charged on the Technical Service ordinary budget for the maintenance of steamers.

The cost of materials bought, and entered in the Arsenal stores amounted to £E.18,137; of this amount materials to the value of £E.5,074 were ordered direct from Europe and £E.13,063 from local merchants.

The quantity of materials delivered from the stores to the Arsenal workshops amounted in value to £E.16,067 and deck stores for the boats to the value of £E.607.

Besides the above, iron and brass castings to the value of £E.3,817 were turned out from the Arsenal foundry during the year and received in the stores. The quantity delivered to different clients amounted in value to £E.4,197 ; the balance, being £E.380 worth, was taken from the stock left in store from the year before.

Labour cost £E.4,907, exclusive of foundry, which has a separate account showing £E.1,284 for labour. The introduction of the new machines has greatly reduced the rate of labour, especially on Iron-work. This can be seen from the following comparison of the rate of labour per ton of steel pipes made for Irrigation during the last three years :—

YEAR.	Rate of labour per ton of pipes.
	£E.
1899	2·48
1900	2·41
1901	2·03

Although these machines were not put to work before half the year was passed the economy in the rate is about £E.0.40 per ton. Thus the saving effected on the 516·6 tons of pipes made for the Irrigation Service this year will be £E.206.6; and as the rivetting, shearing and Bending machine to which this saving of labour is due cost £E.767, the amount saved will be 26·75% of the cost. The Arsenal will not gain much by this economy, as its profits are limited by the Finance to only 10% of the net cost of the articles made in the shops, in fact its profits will be reduced by the tenth of the amount economised ; the real gainers will be the Irrigation Services for whom the Arsenal turns out most of its work.

Steamers.—Before flood season every steamer in the fleet, except the Messir, was thoroughly overhauled and repaired or furnished, as required.

The Messir not being wanted for ordinary irrigation inspection service and only kept for extraordinary commissions, was not taken in hand till late in November. On examination her hull was found to be in a bad condition, and most of it required to be renewed, and as most of the woodwork was also found to be not fit for use again it was decided to do away with it and slightly alter the present arrangement of the cabins so as to give her more berths and more deck room for passengers. These extensive repairs will take from five to six months to finish and will cost at least £E.500 or £E.600.

The total cost of repairs and deck fittings to the steamers amounted to £E.2,000.727 ; the cost of coals and engine stores to £E.2,677.971 ; and the cost of the crew to £E.2,024.587. Thus the total expenses on the boats amounted to £E.6,703.285, shown in detail as follows :—

STEAMERS.	Repairs.		Deck stores.		Coals, oils, etc.		Crew.		TOTAL.	
	£E.	M.	£E.	M.	£E.	M.	£E.	M.	£E.	M.
Nasratieh	172	682	63	418	146	736	293	512	676	348
Messir	107	951	0	282	88	836	94	124	291	193
Tahta	245	673	74	890	307	004	253	540	881	107
Kahira	169	508	22	455	180	081	117	478	489	522
Boulaq	85	171	68	215	386	125	212	650	752	161
Refic	42	155	58	548	267	902	169	931	538	536
Dendera	210	128	205	023	506	990	193	114	1115	255
Rekib...	81	637	62	136	106	064	188	716	438	553
Tawaf	75	252	20	682	158	357	144	643	398	934
No. 1	66	550	17	569	306	309	163	989	554	417
Mœris	35	437	0	333	81	141	16	663	133	574
No. 74	75	422	4	006	53	551	37	152	170	131
No. 25	1	119	9	534	87	268	85	075	182	996
Dredger	24	951	—	—	1	607	54	—	80	558
Total... ...	1393	636	607	091	2677	971	2024	587	6703	285

Before concluding this section of my report I would draw special attention to the good work done in the Arsenal by Mr. Curtis, the Chief Engineer, and his staff, to whose great energy and practical experience the present efficiency of the Arsenal is chiefly due.

M. ANIS,
Chief of Technical Department.

Cairo, 3rd April, 1902.

RAPPORT DU SERVICE DES ANTIQUITÉS

POUR L'EXERCICE 1901

PAR

G. MASPERO

DIRECTEUR GÉNÉRAL

RAPPORT DU SERVICE DES ANTIQUITÉS

§ I. — Service administratif.

Une partie des améliorations indiquées dans le rapport de l'an passé a pu être introduite dans l'administration du Service, grâce à l'augmentation de crédit qui nous a été accordée par le Ministère des Finances pour l'exercice 1901. Cette augmentation qui a été de 578 L.E. en tout, dont 168 L.E. pour les frais de déplacement, nous a permis de multiplier les inspections des Inspecteurs en chef et des Inspecteurs locaux : grâce à ce redoublement d'activité, la protection des monuments et la défense des tells, koms et autres terrains antiques confiés à notre garde a pu être menée de façon plus efficace. Toutefois, les sommes allouées se sont montrées insuffisantes à l'épreuve, et il devient, dès maintenant, nécessaire d'élargir encore cette allocation, si l'on veut confirmer les bons effets obtenus au cours de l'année 1901 ; en la portant à 1,000 L.E. nous aurons, je l'espère, de quoi fournir aux nécessités les plus pressantes pendant plusieurs années.

Inspection du Directeur général. — Elle a duré trois mois, des premiers jours de décembre 1900 aux premiers de mars 1901, et elle n'a pu, faute de temps, insister que sur un petit nombre de localités très importantes de la Moyenne et de la Haute-Égypte. Si, dans plusieurs endroits, à Beni-Hassan, à El-Amarna, à Siout, à Dendérah, au Ramesséum de Thèbes, à Médinet-Habou, à Esnéh, j'ai eu la satisfaction de reconnaître que les monuments étaient en condition assez bonne, j'ai constaté presque partout ailleurs un délabrement et une vétusté croissante, qui sont de nature à nous inspirer des craintes sérieuses pour un avenir prochain. Ainsi, le temple de Séti I^er^ à Abydos m'avait frappé comme ayant vieilli singulièrement depuis la dernière fois que je l'avais vu en 1886. A la fin du mois de septembre dernier, j'y dépêchai M. Legrain pour en examiner toutes les parties, et les conclusions de son examen sont des plus fâcheuses : tandis qu'en 1888, Grand Bey ne trouvait à y faire que des restaurations insignifiantes, d'une valeur de 50 L.E. environ, en 1901, M. Legrain estime que les réparations les plus urgentes exigeront une dépense de 500 L.E. au moins, et son évaluation me paraît demeurer plutôt en dessous de la réalité. Au temple de Luxor, les architraves du petit édifice de Thoutmosis III sont fendues et ne pourraient être maintenues en place qu'à la condition d'être étayées vigoureusement. A Gournah, toutes les chambres postérieures du temple de Séti 1er devront être consolidées l'une après l'autre à brève échéance. Au tombeau du même Pharaon, l'un des piliers qui soutenaient la seconde salle s'est abattu soudain dans la première quinzaine de janvier. En visitant Edfou vers le même temps, les dalles énormes qui recouvrent la salle hypostyle m'avaient paru si endommagées que j'avais pris avec M. Carter les mesures nécessaires pour les consolider au moyen d'un système de poutres en fer. La grande pluie de trente-six heures qui survint quelques jours après précipita les événements, et deux d'entre elles s'effondrèrent successivement : si l'une des bandes de touristes qui envahissent le temple régulièrement en cette saison s'était trouvée sur les lieux au moment de la chûte, nous aurions pu avoir une véritable catastrophe à déplorer. A Philæ enfin, la double colonnade de Tibère, le petit sanctuaire d'Hâthor, la porte et la chapelle des Antonins, le temple d'Auguste, ne résisteront pas à l'effort de l'eau qui les atteindra, lorsque le barrage commencera à produire ses effets, à moins qu'on ne les prépare soigneusement à en subir le contact. Après avoir inspecté l'île longuement avec M. Somers Clarke, plus rapidement avec M. le capitaine Lyons et M. Fitzmaurice, nous en arrivâmes à la conclusion que les travaux, pour être bien conduits, devaient être partagés en deux séries. La reprise en sous-œuvre des fondations nécessite des opérations de nature très complexe dont il eût été peut-être imprudent pour le Service d'assumer la responsabilité : celle des murs et des autres parties visibles rentre au contraire dans notre routine habituelle. Il y a donc lieu de confier la première série à un ingénieur de profession que le Ministère des Travaux Publics désignera : lorsque les sous-sol auront été raffermis entièrement, nous aurons besoin de six ou huit mois afin d'achever la mise en état des superstructures.

Il est résulté pour moi de cette inspection, un peu sommaire encore par endroits, la conviction que les temples et les hypogées de l'Égypte ont beaucoup souffert dans ces derniers temps, et que nous devrons les reprendre les uns après les autres, si nous voulons les conserver dans leur état présent. Le mal semble s'être fait subitement et il a des causes multiples : la principale en est dans les déblaiements non accompagnés de restaurations qui se sont continués depuis un demi-siècle. Les ruines égyptiennes présentent une masse si imposante et elles donnent tellement la sensation de l'indestructibilité, qu'on n'a pas songé dès l'abord à prendre toutes les précautions qu'il aurait fallu au moment où on les dégageait de leur lit de décombres. En déblayant Luxor de 1884 à 1886, j'avais eu le soin de réparer chaque colonne et chaque pan de mur à mesure qu'il sortait de terre : les parties ainsi raffermies n'ont pas bougé depuis lors. Il en a été de même à Médinet-Abou, et sur certains points des édifices de Karnak, mais partout où la consolidation n'a pas marché de front avec le déblaiement, les monuments qui étaient tenus en place par les décombres, perdant soudain cet appui, n'ont plus pu toujours supporter leur propre poids : ils se sont tassés sur leurs bases rongées par le sébakh, leurs parties hautes se sont disloquées, les architraves ou les gros blocs se sont fendus, et il a suffi souvent d'un très petit accident pour déterminer des éboulements considérables. Il est temps encore de remédier à cet état; mais, si la consolidation méthodique n'est pas terminée d'ici vingt ans, je crains bien que le mal ne devienne irréparable, et que nos successeurs n'aperçoivent plus que des tas de pierres informes où nous voyons maintenant des édifices ou des portions d'édifices complets.

Inspecteurs en chef. — L'influence des inspecteurs en chef a continué à s'exercer de la manière la plus heureuse. J'ai dû toutefois modifier légèrement l'étendue de leurs circonscriptions respectives, pour obvier aux inconvénients qui résultaient du partage de la moudirieh de Kéneh entre les deux inspectorats : le territoire entier de cette moudirieh a été englobé dans l'inspectorat du Sud, dont la limite se trouve de la sorte reportée jusqu'à Nag Hamadi. Je n'ai pu, d'autre part, procéder à la création d'un troisième inspectorat supérieur pour le Delta, l'organisation de cette province n'étant pas assez avancée encore en ce qui concerne notre Service.

M. Carter a pu inspecter rapidement la Nubie, jusqu'à Wadi-Halfa, et il a rapporté un projet sommaire de réparation des temples principaux de la région. Ils semblent avoir souffert plus encore que ceux de l'Égypte propre, et le manque presque absolu de gardiens s'y fait cruellement sentir : dans plusieurs endroits, les fellahs en quête de sébakh, n'étant surveillés par personne, poussent leurs fouilles jusque sous les fondations des édifices antiques, et ils ont provoqué l'écroulement de pylones et de chambres entières. A Ibsamboul, la déplorable habitude qu'ont les touristes de grimper sur les genoux du second colosse de droite pour se faire photographier menace de causer un désastre irrémédiable. Les fissures qui sillonnent l'une des jambes se sont élargies sous leurs efforts sans cesse répétés, et il est à craindre que d'énormes fragments ne se détachent ; si cela arrivait, toute la partie supérieure du colosse glisserait et viendrait se briser sur le sol. Le seul gardien que nous entretenons à Ibsamboul n'a ni la force, ni l'autorité nécessaire pour s'opposer aux caprices des touristes. Au Nord de la cataracte, M. Carter a exécuté quelques travaux assez considérables, tels que la construction d'une partie de notre mur d'enceinte à Kom-Ombo et la consolidation du mur qui sépare la grande cour du Ramesséum de la salle hypostyle. Il a réussi à surprendre plusieurs bandes de fouilleurs qui exploitaient la nécropole thébaine et à les mener devant les tribunaux, sans grand résultat pratique, ainsi qu'on le verra plus loin ; par malheur, toute son activité n'a pas empêché le pillage du tombeau d'Aménôthès II.

J'avais, l'an dernier, aménagé ce tombeau de telle manière qu'on pût y laisser la momie du Pharaon sans danger de la part des touristes. Le 24 novembre dernier, dans la nuit de dimanche au lundi, une bande d'indigènes, profitant soit d'une absence momentanée des ghafirs de garde, soit de leur manque de courage, brisa à l'aide d'un levier en fer l'énorme cadenas qui fermait la porte de l'hypogée, et s'introduisant dans les chambres funéraires, tira la momie royale de son cercueil : des mains habiles fendirent le maillot sur la poitrine, à la recherche des bijoux qu'on supposait être cachés à cette place, et laissèrent le cadavre à demi dépouillé sur le sol. La momie nue et sans nom qui était exposée dans l'antichambre fut brisée, avec l'espoir de trouver quelque trésor aux cavités de l'estomac et du ventre : ne découvrant rien, les voleurs épargnèrent les trois personnages qui étaient couchés côte à côte dans l'une des cellules latérales, puis, pour ne pas se retirer les mains vides, ils emportèrent la barque votive sur laquelle la momie de l'antichambre était étendue. L'inspecteur de Gournah, cheikh Mansour, et le réis Mohammed, après avoir constaté les dégâts, prévinrent la police de Louxor et rappelèrent par télégramme M. Carter, alors en inspection à Assouan : l'enquête, menée avec vigueur, aboutit le 30 novembre à l'arrestation de deux des individus qui semblent avoir pris part à l'attaque. Au moment où j'écris ce rapport, les recherches continuent et tout fait espérer que les voleurs, une fois découverts, seront punis rigoureusement. L'incident est fâcheux, en ce qu'il montre combien peu encore nous pouvons compter sur le courage ou sur la vigilance des ghafirs auxquels nous sommes obligés de confier la garde de nos monuments les plus précieux : les dégâts matériels sont, après tout, peu considérables. La momie du Pharaon n'avait sur elle aucun objet de prix, et elle est intacte : la momie brisée avait été déjà fouillée dans l'antiquité par les voleurs thébains ; le bateau enfin, dépouillé depuis des siècles de son ornementation et réduit à ne plus être qu'une carcasse en bois vermoulu, n'a point de valeur vénale, et nous avons au Musée de Gizeh plusieurs autres bateaux du même type mais beaucoup moins endommagés.

L'activité de M. Quibell ne l'a pas cédé à celle de M. Carter, mais, par la force des choses, elle s'est éparpillée sur plus d'objets différents. M. Quibell a été occupé surtout dans le Delta, où la nécessité de lutter contre les empiétements incessants des fellahs nous oblige à une surveillance de tous les instants, mais il a parcouru à plusieurs reprises la Moyenne Égypte du Caire à Nag-Hamadi. Il a pu entreprendre quelques fouilles rapides dans des endroits que nous ne pouvons protéger efficacement et que nous avons, par conséquent, tout avantage à explorer nous-mêmes : il a rapporté ainsi de Kom Echgaou une collection curieuse de fragments byzantins et coptes. Il a rempli avec beaucoup de dévouement une tâche ingrate et lourde.

Inspecteurs locaux. — La création d'un poste d'inspecteur de troisième classe m'a permis d'organiser la surveillance du Delta de la façon que j'avais indiquée dans mon rapport de l'an dernier. Il a été divisé en quatre circonscriptions, dont trois nouvelles : 1° Inspectorat de Zagazig, comprenant les deux moudiriehs de Dakahlieh et Charkieh ; 2° Inspectorat de Benha, comprenant les deux moudiriehs de Ménoufieh et de Galioubieh ; 3° Inspectorat de Tantah comprenant la moudirieh de Gharbieh et la plus grande portion de celle de Béhéra ; 4° Inspectorat d'Alexandrie, comprenant la partie Nord-Ouest de la moudirieh de Béhéra, soit le gouvernorat d'Alexandrie, le district de Mariout et les trois markaz de Rosette, d'Abou-Hommos et de Kafr-el-Dawâr. M. Botti, le conservateur du Musée d'Alexandrie, a bien voulu se charger de l'administration de ce dernier inspectorat, et nous lui en devons d'autant plus de reconnaissance que nous n'avons pu lui accorder l'indemnité à laquelle ce surcroît de charges semblait lui donner droit : c'est au plus si nous sommes en mesure de lui allouer ses frais de déplacement. Les trois autres inspectorats ont été répartis entre Ali effendi Habîb, que j'ai laissé à Zagazig, et dont l'éloge n'est plus à faire, Mohammed effendi Dohéîr, que j'ai appelé du Fayoum pour le mettre à Benha, et un employé nouveau : Nésîm effendi Yousef, qui nous avait été recommandé par le Ministère des Finances et dont nous n'avons qu'à nous louer pour le moment. Au 1^er^ décembre 1901, Mohammed effendi Dohéîr a été mandé au Caire pour prendre part au déménagement, et son inspectorat placé provisoirement aux ordres de Nésîm effendi Yousef pour le Ménoufieh, d'Ali effendi Habîb pour le Galioubieh : il reprendra son poste sitôt que le déménagement sera terminé. J'ajoute, pour en finir avec ce qui concerne le Delta, que j'ai décidé de confier au Musée d'Alexandrie tous les monuments qui viendraient à être découverts dans le quatrième inspectorat, qu'ils fussent égyptiens ou grecs.

Le nombre et la répartition des inspectorats de la Haute Égypte sont demeurés les mêmes que l'an dernier, mais il y a eu des changements dans le personnel. Deux inspecteurs nouveaux ont été nommés en remplacement de deux autres qui avaient été reconnus insuffisants, Salib effendi Risk, ancien officier de l'armée, à Abydos, et le cheikh Mohammed Mansour à Gournah. Sobhi effendi Arif a été transféré de Dendérah au Fayoum où il a achevé de remettre l'ordre : cette province, l'une de celles où la surveillance est le plus difficile à cause de l'exploitation à laquelle l'ont soumise les marchands d'antiquités, reprend peu à peu sa marche régulière, et Sobhi effendi a réussi à enrayer sur quelques points l'activité des fouilleurs clandestins par des surprises heureuses, qui ont amené la confiscation de divers lots de papyrus, et, en dernier lieu, d'une curieuse statue d'époque romaine. Somme toute, l'autorité du Service s'affermit presque partout, et, le succès excitant le zèle de nos inspecteurs indigènes, j'ai tout lieu d'espérer que l'amélioration s'accentuera d'année en année.

Qu'il me soit permis, en attendant, d'attirer l'attention sur le traitement qui leur est fait. Réglé à une époque où la vie coûtait moins cher, il n'a pas été augmenté depuis lors, et il est notoirement insuffisant aujourd'hui. Le recrutement, difficile en tout temps, menace de devenir plus difficile encore, et c'est à grand peine si j'ai trouvé cette année trois hommes présentant les garanties nécessaires pour remplir les trois postes qui étaient vacants. Nous ne pourrons attirer et retenir des employés doués des qualités que la fonction exige qu'à la condition de relever le traitement d'entrée des inspecteurs de troisième classe de 48 L.E. à L.E. 60 et de porter leur cadre de L.E. 48-60 à L.E. 60-96; d'augmenter le nombre des inspecteurs de seconde classe, et de créer une seconde place d'inspecteur de première classe. La dépense serait minime et nous aurions le droit d'exiger de cette catégorie d'employés plus et mieux qu'ils ne font actuellement.

Gardiens. — Le nombre de nos ghafirs permanents, qui était de 191 l'année dernière, a été porté à 197 dans le courant de la présente année, et la répartition en a été modifiée quelque peu, pour les besoins de l'organisation nouvelle du Delta.

A fin novembre 1901, il étaient distribués entre les inspectorats et rémunérés comme suit :

INSPECTORAT	Nombre	PAYÉS EN LIVRES ÉGYPTIENNES.			
		Sur Ch. 1 § 2.	Sur Ch. 2 § 1.	Sur le fonds des touristes.	Sur les fonds des Carrières.
Benha	2	—	12	12	—
Zagazig	8	48	12	36	—
Tantah	4	—	24	24	—
Fayoum	18	132	60	36	—
Rodah	24	81.600	18	132	—
Abydos...	13	36	24	105	—
Dendérah	14	12	12	146.400	27
Louxor...	12	—	—	150	—
Gournah	36	12	144	284	—
Edfou	9	24	—	79.200	—
Assouân	10	60	—	60	—
Gizeh	7	54	—	66	—
Sakkarah	33	203.400	—	312.600	—
Mit-Rahineh	7	42.600	—	61.200	—
Total...	197	705.600	306	1,504.800	27

Cette année encore, j'insisterai sur la situation anormale qui est faite à notre Service. La plus grosse partie de ces traitements est imputée sur les ressources variables que nous fournissent les fonds des touristes et celui des carrières, soit 1,531 L.E. 800 sur un total de 2,740 L.E. 400. La nécessité de veiller sur les localités excentriques aussi bien que sur les grands sites monumentaux nous oblige à dépenser en frais de gardiennage la plus grande partie des sommes qui, comme le fonds des fouilles et celui des touristes, devaient être consacrés au déblaiement, à la consolidation et à l'entretien des monuments. Une circonstance fortuite qui éloignerait les voyageurs pour une année nous contraindrait à licencier plus de la moitié des ghafirs, et à laisser des sites très importants sans défense contre les entreprises des chercheurs d'antiquités.

Vente des matériaux anciens et prise du sébakh ou de la terre sur les sites antiques. — La vente des *chakfs* et des autres matériaux, mieux réglée, a donné des résultats supérieurs à tous ceux que nous avions obtenus jusqu'à présent : le produit au 30 novembre en était de 525 L.E. 405. Cette somme ne représente pas toutes les sommes que nous aurions pu encaisser de ce chef ; dans les sites en effet où nous n'avons pas de gardiens à demeure, il est d'usage de prélever le salaire des ghafirs installés provisoirement jusqu'à la fin de l'exploitation, sur les prix versés par les acheteurs. Les recettes de cette année nous ont permis, en premier lieu, de diminuer de L.E. 250 la dette Morgan, puis de payer les frais d'impression des ouvrages qui seront mentionnés plus loin, à l'article *Publications.*

Le projet de règlement que j'avais présenté l'an dernier sur la prise du *sébakh* a été approuvé avec quelques amendements par les différents ministères qu'il intéressait, et les dispositions en ont été mises en vigueur par le moyen d'une circulaire du Ministère de l'Intérieur, en date du 31 août 1901, adressée aux moudirs, aux gouverneurs, et d'une manière générale aux chefs des grandes administrations gouvernementales. Depuis lors, il a été appliqué sans difficulté sérieuse, et la surveillance du Service a pu s'exercer avec plus d'efficacité sur des sites qui lui échappaient entièrement. Des trouvailles heureuses ont montré quel profit le Musée en tirera, au fur et à mesure que l'application deviendra plus générale et plus régulière ; c'est ainsi qu'il a reçu un petit trésor de bijoux byzantins en or provenant de Tell-Ramsis, une statue trouvée aux Kimân-Fares, un colosse d'Achmounéin, pour ne citer que les objets les plus importants.

Affaires contentieuses et projet de loi sur les antiquités. — A vouloir défendre les droits de l'État égyptien sur les monuments qui sortent du sol et sur les terrains antiques, le Service s'expose à entrer en conflit perpétuel avec les marchands ou les fouilleurs ainsi qu'avec les paysans qui tendent sans cesse à usurper les terrains du gouvernement. L'insuffisance notoire de la législation actuelle en ce qui concerne les questions juridiques relatives aux antiquités m'a déterminé à agir avec une extrême prudence, et à n'accepter ou à n'engager que les procès où notre droit me semblait être évident. Grâce à cette précaution, nous avons eu le dessus dans deux ou trois affaires assez importantes pour créer des précédents en notre faveur, affaire Mégalli-Kilada et Farag es-Sayed pour commerce d'antiquités volées notoirement, affaire de Dahshour pour fouilles nocturnes dans la nécropole memphite, affaire Abdoulmekki pour usurpation de terrains antiques appartenant à l'État. La faiblesse des peines prononcées est telle malheureusement que, dans certains cas, les voleurs en sont moins découragés qu'encouragés à persévérer dans leurs pratiques. Pour n'en citer qu'un exemple, M. Carter, ayant surpris au mois d'octobre dernier deux des bandes qui exploitent la nécropole de Thèbes, les gens qui les composaient furent condamnés les uns à 5 les autres à 15 P.E. d'amende : un mois plus tard, l'attaque sur le tombeau d'Aménothès II avait lieu.

Il m'a paru qu'il y avait intérêt à réunir en un seul corps les dispositions des lois, décrets et circulaires qui furent promulgués sur la matière depuis le règne de Mohammed-Ali, et de les compléter où il serait utile. J'ai donné à cette compilation la forme d'un projet de loi qui, examiné officieusement par le contentieux du Ministère des Travaux publics, est soumis en ce moment au Comité d'archéologie. J'espère qu'il pourra être discuté au cours de l'an prochain : si le gouvernement en adopte les principes, nous aurons enfin une arme qui nous permettra de lutter sans trop de désavantage contre les fouilleurs clandestins et contre les destructeurs de monuments.

§ II. — FOUILLES ET RÉPARATIONS.

Fouilles des particuliers et des sociétés savantes. — La plupart de ces fouilles, ayant été déjà ou devant être prochainement l'objet de publications détaillées ou de rapports de la part des savants qui les ont exécutées, j'en signalerai très brièvement ici la nature et les résultats.

L'Académie de Berlin a complété les travaux qu'elle avait commencés à Abousir, et l'Institut français d'archéologie a poussé vigoureusement le déblaiement des restes de la pyramide du roi Didoufrî, à Abou-Roach, au nord de Gizèh : M. Chassinat a eu l'heureuse fortune de découvrir les fragments de nombreuses statues du Pharaon, de la reine et des personnes de leur famille, et quelques pièces sont d'un fort beau style. M. Clédat a terminé la copie des peintures des tombeaux de Méîr et commencé l'exploration des ruines du couvent copte de Baouît.

M. Gayet a continué les fouilles qu'il dirige à Cheikh-Abadéh et dans le voisinage pour le compte du Musée Guimet de Paris. Il y a recueilli son butin ordinaire d'étoffes et de momies byzantines, et, dans le nombre, les momies d'un anachorète du nom de Sérapion et d'une certaine Thaïs, qui ont excité beaucoup de curiosité lorsqu'elles furent exposées à Paris.

MM. Grenfell et Hunt ont exploité avec leur bonheur accoutumé toute la région nord-est du Fayoum, et M. Pierre Jouguet a entrepris avec les subsides du gouvernement français l'exploration méthodique du bassin de Gharak et du site de Médinet Madi. Les nombreux fragments de papyrus qu'ils ont découverts ont été emportés en Angleterre et en France pour y être déroulés et déchiffrés : le partage entre les inventeurs et le Service n'aura lieu, selon l'usage, que lorsque l'étude en sera achevée.

M. Reisner, après en avoir fini avec le site de Déîr, a attaqué la montagne située sur la rive droite du Nil en face de Girgèh, de Mécheikh à Naga-ed-Déir : il y a trouvé une nécropole préhistorique à laquelle sont venus se superposer plus tard des cimetières de l'époque memphite. De l'autre côté du Nil, M. Flinders Petrie a continué le déblaiement des sépultures royales appartenant aux dynasties thinites, et M. Garstang, agissant pour le compte de l'*Egyptian Research Account* a mis au jour, près de Beit-Khallaf, le mastaba d'un nouveau Pharaon archaïque. La fin de cette campagne a été attristée par la mort de l'un des jeunes gens qui aidaient M. Petrie ; M. Anthony Wilkin succomba au Caire le 17 mai 1901, aux suites d'une dysenterie qu'il avait contractée sur les chantiers de fouilles.

M. Newberry avait demandé l'autorisation de dégager les tombes de Cheikh Abd-el-Gournah, qu'il se propose de publier *in-extenso* : c'est une œuvre de longue haleine et qui lui prendra plusieurs années. Les hypogées qu'il a déblayés seront garnis de portes par lui et entretenus désormais aux frais du Service.

Enfin Daninos pacha, après avoir opéré des sondages près de Hawarâ, sans grand succès, a eu la chance de trouver au Kom-el-Azîz, sur l'emplacement de l'ancienne Memphis, des bronzes de l'époque saïte, entassés dans une cachette antique. La trouvaille était si importante qu'il m'a paru utile de ne pas en disperser les éléments : nous avons racheté la moitié qui revenait à Daninos pacha pour une somme de 300 L.E.

Fouilles et réparations du Service des antiquités. — Le Service a opéré quelques fouilles sur plusieurs points du territoire où on lui signalait des restes d'antiquités menacés par les chercheurs locaux. M. Daressy a mis au jour, sur le Kom-el-Azîz, les restes d'un édifice d'époque romaine ou byzantine, dans la construction duquel des fragments d'un temple de Nectanébo I^er^ avaient été réemployés. Il a également, pendant trois semaines, sondé un des quartiers de l'ancienne Saïs, dans l'espoir d'y découvrir des bronzes pour notre salle de ventes. Cet espoir a été déçu. Il a enfin parcouru, quelques jours durant, la nécropole ptolémaïque de l'ancienne Aphroditopolis Magna, aujourd'hui Atfiéh, dans la province de Gizèh : il y a copié les inscriptions d'un des rares tombeaux qui portaient une décoration. Les rapports de ces fouilles ont paru ou paraîtront aux tomes II et III des *Annales du Service.*

Ahmed bey Kamal, envoyé en inspection à Tell-Faraîn, sur l'emplacement de l'ancienne Bouto, et dans la province de Siout, a rapporté de ces courses la matière de deux rapports qui ont été publiés également dans les *Annales*. Après deux mois de travail à El-Berchèh, il a réussi à déblayer un puits profond de plus de quarante mètres, qui aboutissait au caveau encore intact où reposait la momie d'un certain Thotnakhîtî, contemporain des rois de la XII^e Dynastie. Les sarcophages, en bois, du mort, son mobilier funéraire, ses bijoux étaient assez bien conservés et sont déposés au Musée : le rapport d'Ahmed bey sur cette trouvaille intéressante a été inséré dans nos *Annales.*

Au mois de janvier 1901, les preneurs de *sébakh* dégagèrent à Achmounéîn les restes de plusieurs édifices de style égyptien. L'inspecteur de Rodah, Mohammed effendi Chabân. les fît déblayer à fond, et, lors de mon passage, en février 1901, je reconnus un reste de muraille en calcaire blanc, portant des tableaux du Pharaon Amenemhaît II de la XII^e Dynastie ; plus loin, des débris au nom de Khouniatonou et de Ménephtah apparaissaient encastrés dans les murs d'un édifice d'époque romaine. Quelques mois plus tard, d'autres preneurs de *sébakh* rencontrèrent à peu de distance un colosse en beau granit rose. M. Perrichon bey, directeur de l'usine de Rodah, qui se trouvait sur les lieux, empêcha les fellahs de casser la tête pour la vendre aux marchands d'antiquités de Mellaoui, et me prévint par dépêche : c'est à lui seul que nous devons de posséder intact ce beau monument. Le colosse, qui représente Ramsès II, mais qui a été usurpé par Ménephtah, est aujourd'hui au Musée. L'inspecteur de Rodah a déblayé derrière l'endroit où il se trouvait les premières salles d'un temple en ruines sur les murs duquel on lit les noms de Ménephtah et de Séti II. C'est l'une des parties du grand temple de Thot que le hasard nous livre ainsi : le déblaiement continuera en 1902, moitié à nos frais, moitié par le moyen des preneurs de sébakh, et je compte qu'il nous rendra des inscriptions et des statues de valeur.

A Sakkarah, M. Barsanti a repris le déblaiement de la pyramide d'Ounas : il a dégagé la moitié de la façade Est, découvert les huit colonnes à chapiteaux en feuilles de palmier qui ornaient le portique de la chapelle, vidé la plus grande partie des souterrains et poussé si loin le travail qu'il pourra l'achever sans peine dans la campagne de 1902. Il a découvert, au cours des déblais, un puits d'époque saïte, celui de Péténéit, intact comme les puits vidés l'année précédente : la momie avait sur son maillot un petit trésor d'amulettes emboutis dans des feuilles d'or mince. Une tentative de vol à Dahshour m'a décidé à faire dégager par M. Barsanti, tout un quartier de la nécropole, le plus exposé aux entreprises des voleurs : un beau pyramidion en granit noir, d'un Amenemhaît, et des fragments de bas-relief d'un style admirable sont venus enrichir nos collections. Les rapports de M. Barsanti et la copie que j'ai faite des inscriptions de Péténéith ont été publiées dans les *Annales.* Entre temps, le rèis Khalifah opérait, pour le compte du

Muséum d'Histoire Naturelle de Lyon, des sondages dans les cimetières d'animaux de Sakkarah, et il en retirait des momies d'oiseaux, de chiens, de chats, de bœufs que M. Lortet, de Lyon, prépare pour être exposées au Musée du Caire. Enfin des tranchées, poussées dans les endroits favorables par le rèis Roubi, ont fourni à notre Salle de Ventes une quantité considérable de ces petits amulettes en faïence émaillée que les touristes réclament avant tout.

A Thèbes, M. Carter a terminé la consolidation du mur du Ramesséum et mené assez loin le déblaiement des autres parties de ce temple. Il a ouvert dans la Vallée des Rois un tombeau, celui de Sonnaî qui avait été malheureusement dévasté au commencement du XIX^e siècle. L'effort principal, à Thèbes, a porté sur Karnak, où M. Legrain poursuit la réparation de la Salle Hypostyle.

Travaux de la Salle Hypostyle et du temple de Karnak. — Ainsi que nous l'avions promis au début de ces travaux, le déblaiement de la Salle Hypostyle a été terminé dès les premiers jours d'avril. Les tronçons de colonnes qui demeuraient épars sur le sol ont été enlevés et transportés dans le magazin que nous avions établi entre le temple d'Amon et le temple de Phtah. Le terrain une fois libre, une sous-commission composées de MM. Verschoyle, Ehrlich, Manescalco Bey, Maspero, Legrain, auxquels se joignirent MM. Barois et Lyons, membre du Comité d'Archéologie, examina les fondations des colonnes écroulées, et constata qu'elles étaient entièrement saines. Dans le procès-verbal, rédigé à Karnak, le vendredi 19 avril 1901, elle proclama la possibilité de relever les colonnes et elle indiqua les moyens qui lui avaient paru le plus convenable à cet effet. Le Comité d'Archéologie n'a pas encore choisi entre ces moyens, et la réfection des fondations est reculée jusqu'au moment où les dernières eaux d'infiltration auront disparu du sol de Karnak, c'est-à-dire jusqu'au mois d'avril 1902.

Tandis que l'enlèvement des colonnes s'achevait, M. Legrain, en exécution des instructions qu'il avait reçues, terminait la réparation du temple de Phtah et celle du temple de Khonsou, ainsi que la clôture du temple d'Amon. En expropriant le hameau dit Moulgattah, en comblant les brêches que le mur antique en briques présentait sur son front Est, et en mettant à toutes les portes du temple ou de l'enceinte des grilles solides en bois, nous avons réussi à fermer la majeure partie des ruines. J'espère que l'expropriation de quelques maisons dans la section méridionale de la commune de Karnak nous permettra de relever les portions détruites de l'enceinte au Sud-Est et de compléter ainsi la clôture.

Au cours de ces travaux des monuments très intéressants ont reparu au jour, entre autres une statue du dieu Khonsou qui est l'un des chefs d'œuvre de la sculpture thébaine sous la XVIIIe Dynastie.

La campagne de Karnak, interrompue le 18 juin, a repris dans les derniers jours de septembre, toujours sous la direction de M. Legrain, et, en attendant qu'une décision du Comité nous autorise à refaire les fondations de la Salle Hypostyle, j'ai mis les ouvriers dans un endroit où mes souvenirs de 1884-1886 m'inclinaient à penser qu'il y avait de bonnes trouvailles à opérer. M. Legrain a dégagé en effet, le long de la façade Nord du pylone n° VII, un groupe de quatorze statues et colosses d'époques différentes parmi lesquelles trois sont de la XIIIe dynastie, un Sovkhotpou, un Sovkemsaouf et un Ousirtasen encore inconnu qui prend provisoirement rang dans les listes royales comme Ousirtasen IV. Tout me porte à croire que la chance ne nous abandonnera pas, et que l'avenir nous réserve encore plus d'une surprise dans cet endroit du temple.

Les dépenses occasionnées par les fouilles et réparations du Service se sont réparties ainsi qu'il suit sur nos différents comptes :

NOM DE LA LOCALITÉ.	Compte Fouilles.	Compte Touristes.
	L.E. M.	L.E. M.
Sa-el-Hagar … … … … … … … … …	31.510	—
Tell-Gomâa … … … … … … … … …	22.580	—
Mit-Rahynèh … … … … … … … … …	10.720	—
Sakkarah… … … … … … … … … …	530.460	183.394
Achmounéîn … … … … … … … … …	85.650	—
El-Berchéh … … … … … … … … …	47.892	—
El-Amarna (tombeau de Khouniatonou) … … …	—	1.920
Illahoun … … … … … … … … … …	1.100	—
Dahchour … … … … … … … … …	9.550	—
Cheikh-Saîd … … … … … … … … …	4.090	—
Kom-Echgaou … … … … … … … …	13.004	—
Thèbes-Ramesséum … … … … … … …	—	126.185
Gournah… … … … … … … … … …	—	5.075
Déir-el-Baharî … … … … … … … …	15.525	10.105
Médinét-Habou … … … … … … … …	—	9.309
Tombeaux thébains … … … … … … …	—	7.820
Tombeau d'Aménôthès II … … … … … …	—	48.226
El-Kab … … … … … … … … … …	—	4.360
Edfou … … … … … … … … … …	—	57.305
Kom-Ombo … … … … … … … … …	—	36.764
Louxor … … … … … … … … … …	—	153,530
Portes en fer pour tombeaux … … … … …	—	53.991
Divers … … … … … … … … … …	5.595	—
Gratifications… … … … … … … … …	58.200	—
Achats … … … … … … … … … …	126.055	—
Total … … …	961.931	697.984

Les dépenses sur le compte *fouilles* sont calculées du 1^{er} janvier au 31 décembre 1900, celles sur le compte *Touristes* du 30 juin 1900 au 30 juin 1901.

Les dépenses des travaux éxécutés à Karnak sont imputées sur le crédit spécial que la Caisse de la Dette a ouvert au Service pour ses travaux extraordinaires; ce crédit est de L. E. 4000 par an, dont L. E. 2000 pour Karnak. Ces L.E. 2000 ont été employées cette année de la manière suivante :

Dépenses Karnak du 1er Décembre 1900 au 1er Décembre 1901.

	L. E.	Mill.
Déblaiements et réparations	1387	715
Achat de matériel	474	477
Réparation et entretien du matériel..	11	700
Transport du matériel	25	140
Transport du personnel et frais de déplacement	79	713
Divers	13	710
Total	1992	455

§ III. — LE MUSÉE ET LES PUBLICATIONS.

Augmentation des collections. — Elles se sont accrues de façon normale: 584 monuments nouveaux y sont entrés (n^{os} 34731-35315) provenant partie des fouilles et achats du Service, partie des fouilles opérées par des savants étrangers avec l'autorisation du Service. Parmi ceux de la première série, on remarque le colosse d'Achmounéîn (XIX^e dynastie), la statue de Khonsou (XVIII^e dynastie), les bijoux de Péténéît (époque persane), trois petites statues d'un même individu trouvées à Berchéh (XI^e-XIII^e dynasties), une chaîne en or avec pendeloques de l'époque byzantine, deux des colonnes de la chapelle funéraire d'Ounas (V^e dynastie), les sculptures sur bois d'époque copte provenant de Baouît. Les principaux objets dérivés des fouilles privées sont les quatre bracelets en or, en améthyste et en pâtes de verre, découverts sur la momie d'une reine de la 1^{re} dynastie, les vases à parfums encore bouchés de leur feuille d'or, et la collection de vases à cartouches thinites qui représentent notre part du butin fait par M. Petrie à Abydos, plusieurs momies byzantines de celles recueillies par M. Gayet à Cheik Abadèh, enfin les beaux bronzes saites de Daninos Pacha.

Préparatifs du déménagement et aménagement du Musée nouveau. — L'emballage des petits objets a été achevé, et nous avons maintenant tout près de quatre cents caisses prêtes au transport. Elles contiennent tous les objets exposés jadis dans les vingt-six salles 43-69. Les cercueils, les sarcophages et les objets funéraires compris dans les dix salles 76-83, 85-87, sont en voie de réparation et pourront être empaquetés de linge à partir de la première semaine de janvier. Enfin, dans les salles du rez-de-chaussée, toutes les stèles et toutes les statues de l'Ancien et du Moyen Empire qui exigeaient des soins particuliers ont été emballées avec soin. Les caisses portent, tracés aux couleurs bleue ou rouge et à l'encre noire, les numéros des objets qu'elles renferment et les indications nécessaires à faciliter le classement dans le Musée nouveau. J'ai laissé en ordre et ouvertes au public toutes les salles du rez-de-chaussée et celles du premier étage qui attirent le plus la curiosité des visiteurs, les salles 70 (objets de toilette et bijoux), 71 (Scarabées), 72 (Statues et statuettes des divinités), 73 (Fleurs, graines et fruits recueillis dans les tombeaux), 74 (Monuments de l'époque préhistorique et des dynasties thinites), 84 (Momies royales). Elles demeureront accessibles jusqu'en mai 1902, et j'espère mener assez vite le déménagement, pour que le Musée du Caire puisse ouvrir quelques semaines au plus après que les dernières salles de Gizéh auront été fermées.

Après avoir pris livraison provisoire du Musée nouveau en septembre 1901, nous avons reçu les clefs des portes le samedi 30 novembre, constatant, d'accord avec les entrepreneurs et les délégués de la Direction des bâtiments civils, quelques imperfections et l'absence de la peinture rouge dans les salles du rez-de-chaussée : engagement a été donné par les entrepreneurs d'avoir terminé ces derniers travaux au 1^er^ février 1902. L'ascenseur devra également fonctionner à cette date. La charge entière du Musée nouveau a été remise aussitôt à Mohammed effendi Dohéir, inspecteur de Benha, que j'ai appelé au Caire et qui y demeurera avec la responsabilité afférente jusqu'à l'achèvement du déménagement. Une garde provisoire de deux farraches et de quatre ghafirs lui a été adjointe, qui sera augmentée au fur et à mesure que les objets arriveront. Les menuisiers du Service avaient déjà pris possession des salles du bas et avaient commencé à y fixer les tablettes qui supporteront les stèles le long des murs : les lettres par lesquelles les salles seront désignées provisoirement, ont été accrochées aux murailles, et l'on a procédé aussitôt au transfert des vitrines. Elles avaient été préalablement démontées, empaquetées et numérotées : le mardi 3 décembre, un premier lot, embarqué sur le sandal du Service qui avait été réparé pour la circonstance, fut traîné jusqu'au débarcadère qui nous a été attribué, par le remorqueur n° 1 qui avait été mis à notre disposition par le chef du Service technique, Mohammed Anis bey, et les vitrines emmagasinées le même jour au rez-de-chaussée des bâtiments nouveaux.

*

Le transport par eau fut achevé en quatre voyages, le samedi 7 décembre, et le montage commença. Le site que chaque vitrine devait occuper avait été déterminé à l'avance; l'opération prit donc fort peu de temps, et la mise en place était achevée le 11 décembre. Cela fait, fixer chaque armoire au mur ne fut plus que l'affaire de quelques jours. Tous ces travaux préliminaires ont été exécutés par M. Barsanti, et ils ont été conduits avec toute la rapidité et toute l'habileté désirables. Un seul panneau de verre a été légèrement écorné dans le transport : tout le reste est arrivé intact à la place qui lui avait été assignée.

En ce qui concerne le Service, tout est préparé pour l'enlèvement des monuments. Si l'administration des Chemins de fer nous livre les deux tronçons de voie qui raccordent les deux musées à la ligne de la Haute-Egypte dans le courant du mois de janvier, ainsi qu'elle a promis de le faire, le déménagement pourra commencer vers le milieu de février. Les petits objets et les caisses qui les renferment partiront les premiers en trois ou quatre trains au plus, et seront dans les salles nouvelles vers les premiers jours de mars : tandis qu'on les rangera dans les vitrines, M. Barsanti procédera au déplacement des grosses pièces, ce qui exigera plusieurs mois. La rédaction et l'impression du catalogue pourront marcher de front avec la mise en place ; il y a tout lieu d'espérer qu'à l'automne de 1902, au retour des touristes, le musée sera ouvert de nouveau et accessible à tous. Le classement définitif commencera alors et se poursuivra plusieurs années, mais il pourra se faire par sections et sans qu'il soit nécessaire de fermer au public plus d'une ou deux salles à la fois.

Bibliothèque du Musée. — Le crédit de L.E. 300 qui avait été accordé l'an passé sur le produit de la salle de vente et des entrées n'a pas été épuisé complètement : au courant de l'année 1901 nous avons employé L.E. 226.334 mill. en achats de livres et L.E. 22.610 mill. en reliures, soit pour l'ensemble L.E. 248.944 mill. Une partie des ouvrages que nous nous sommes procurés avait paru dans l'année ; d'autres sont déjà vieux et ont été achetés d'occasion pour compléter nos séries, selon le programme que j'ai exposé sommairement dans mon rapport de l'an dernier. Nous avons reçu de plus un certain nombre de brochures et de livres en don des auteurs, et nous espérons que ces contributions volontaires s'augmenteront avec le temps. Nous avons enfin consenti l'échange de certaines de nos publications contre celles de divers corps savants : je citerai, parmi ceux qui sont ainsi en rapport avec nous, l'Institut des Bollandistes, la Bibliothèque Nationale de Paris, l'Institut Archéologique Français du Caire, l'Institut Égyptien et la Société de Géographie du Caire.

Publications du Service des Antiquités. — Les deux volumes de M. de Morgan, Kom-Ombo et Dahchour II ont progressé lentement, partie à cause de certaines lacunes que nous avons constatées dans les manuscrits de l'auteur, partie à cause du retard que M. Legrain, très occupé par les travaux de Karnak, apporte à corriger les épreuves. J'espère pourtant que l'un au moins de ces volumes sera terminé au cours de l'année 1902.

Les *Annales du Service* ont pu paraître à peu près régulièrement. Le premier volume a été achevé dans les premiers mois de l'année courante, et les trois livraisons qui composent le second volume auront paru au 31 décembre, malgré les difficultés de l'impression. Le papier de ce second volume est meilleur, et les clichés insérés dans le texte sont d'une meilleure exécution : l'aspect extérieur de l'ensemble est plus satisfaisant que celui du premier volume. Les planches ont été multipliées autant qu'il a été possible, et les mémoires reproduits ont été choisis de manière à donner une idée exacte de l'activité du Service pendant l'année qui vient de s'écouler. J'espère qu'avec le troisième volume les derniers défauts qu'on était en droit de reprocher aux volumes précédents seront devenus presque insensibles.

L'abondance des beaux monuments que nous découvrons me porte à croire que nous serons obligés prochainement à publier un second volume du *Musée Égyptien.*

Le Catalogue général du Musée. — La Commission du Catalogue a été composée de trois membres seulement, MM. de Bissing, Edgar et Lacau : selon la décision prise l'an dernier par le Comité d'Archéologie, un savant Autrichien de passage au Caire, M. Strzygowski, de l'Université de Gratz, a été attaché pendant quatre mois à la Commission avec une indemnité de L.E. 133.012, mill., pour faire l'inventaire des monuments byzantins et coptes du Musée.

Deux des volumes mis à l'impression l'année passée ont été publiés au courant de l'année 1901, celui de M. Daressy sur les *Ostraca* (en français), celui de M. de Bissing sur les *Vases en métal* du Musée (en allemend), le premier imprimé au Caire par l'Institut français d'Archéologie Orientale, le second imprimé à Vienne par A. Holzhausen. Deux autres volumes, qui s'impriment à l'Institut français, sont presque achevés, celui de M. Crum sur les *Monuments coptes* (en anglais), et celui de M. Daressy sur les objets découverts par M. Loret dans les tombeaux de *Maherpra, Aménothès II et Thoutmosis III* (en français). Deux autres sont assez avancés, celui de M. de Bissing sur les *Vases en faïence* (en allemand), et celui de MM. Lange-Schæfer sur les *Stèles* *du Moyen Empire* (en allemand), qui s'impriment le premier à Vienne chez Holzhausen, le second à Berlin dans l'Imprimerie Royale. Enfin, le volume de M. Chassinat sur la *Seconde trouvaille de Déir el Bahari* est en bon train et pourra très probablement nous être livré par l'Imprimerie de l'Institut français dans le cours de l'année 1902 ou 1903.

Trois volumes m'ont été remis par leurs auteurs et seront envoyés à l'Imprimerie du Caire, aussitôt que les dessins qui doivent les accompagner seront terminés et les clichés exécutés, celui de M. Lacau sur les *Cercueils du Moyen Empire* et ceux d'Ahmed Bey Kamal sur les *Stèles hiéroglyphiques de l'époque gréco-romaine* et sur les *Tables d'offrandes;* le volume de M. Quibell sur les *Monuments des époques thinite et préhistorique* (en anglais), et celui de M. Strzygowski sur les *Monuments byzantins et coptes*, sont presque terminés et me seront livrés à bref délai. Enfin M. Wilcken remanie son volume sur les *Ostraca* grecs pour le conformer au plan nouveau du Catalogue, tel que les volumes publiés de MM. de Bissing et Daressy le lui ont fait connaître. M. Milne en agit de même pour son *Catalogue des stèles grecques et latines.* M. Edgar termine son inventaire des objets gréco-romains.

Plusieurs portions nouvelles de nos collections ont été abordées cette année-ci. M. de Bissing a entrepris de décrire les armes et les bijoux, M. Daressy les amulettes de grande taille, cippes d'Horus, etc., M. Lacau les stèles du Second Empire thébain et de l'époque saïte, M. Maspero les cercueils et sarcophages en pierre du Second Empire thébain ainsi que ceux des temps saïtes et grecs. Une partie au moins de cette série nouvelle de volumes sera prête vers la fin de 1902.

Les ressources que la Caisse de la Dette a bien voulu mettre à notre disposition suffiront amplement à couvrir les frais de cette énorme publication. Je puis dire d'ores et déjà que l'impression produite sur le monde savant par les deux premiers volumes a été excellente, et je compte que les volumes suivants non seulement ne la diminueront pas mais l'accroîtront encore.

Le Directeur général,
G. MASPERO.

Bellianéh, le 16 Décembre 1901.

REPORT ON AGRICULTURAL LINES

1901

BY

A. J. COTTERILL.

REPORT ON AGRICULTURAL LINES.

Cairo, 31st December, 1901.

Sir William Garstin, K,C.M.G.,
Under Secretary of State,
Ministry of Public Works.

Sir,

I beg to hand you my annual report on the Egyptian Agricultural Lines.

From the annexed Table No. II it will be seen that 761 kilometres (472·7 miles) were originally given in concession to four Companies and that 1017·8 kilometres (632 miles) have been laid, and are being worked at the present moment.

Length of lines.

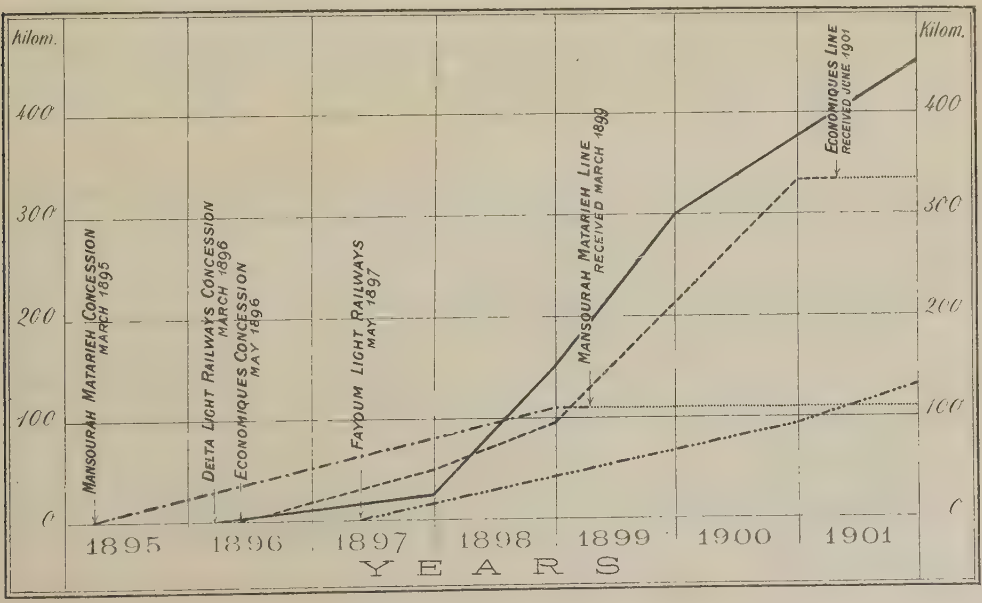
The total length of lines opened to traffic were as below :—

December,	1897	87·8	kilometres	54·5	miles.
,,	1898	355	,,	221·25	,,
,,	1899	694·5	,,	430	,,
,,	1900	920·8	,,	572·1	,,
,,	1901	1,017·8	,,	632·4	,,

Rate of construction.

The diagram below shows the approximate dates of the commencement and reception of the lines and the speed at which they were constructed.

DIAGRAM



The rate at which the lines were made is roughly—

(1) Mansourah-Mattarieh... ...	27·5	kil. per annum	(to date of reception).
(2) Chemins de fer Economiques	66·5	„	(„).
(3) Delta Light Railways... ...	76·8	„	(to present date).
(4) Fayum Light Railways ...	28	„	(„).

The concession of the Chemins de fer Economiques having been acquired in September, 1900, by the Delta Light Railway Company, the latter title will be used in this report for these two Companies combined.

Telegraph and Telephones.

Since last year there has been an increase of only 32 kilometres (20 miles) of telegraphic communication. It is evident that the lack of it on the Delta lines is a great inconvenience. In the case of breakdowns and in working special trains this is an element of danger that should be removed. I am glad to hear that the Delta Company intends to lay further wires.

The actual lengths of telegraph and telephone wire are as below :—

(1) Mansourah-Matarieh	109·8 kil.	=	68·25 miles.
(2) Delta Light Railways (including Economiques)	391·5 „	=	243·27 „
(3) Fayum Light Railways	152 „	=	94·45 „
	653·3 kil.	=	405·97 miles.

Level crossing with State Railways.

During 1901 four level-crossings have been worked. Two of these were used only for passing rolling-stock at intervals when required, and two for the crossing of regular train services.

No accident has happened on any of these crossings, though on one occasion there were all the elements required to cause a serious collision, and on another occasion a passenger train was derailed by the throw-off points and the driver was killed. I repeat, the unanimous opinion of engineers on these level crossings is: "They are seldom economical and always a source of danger."

Working expenses and their ratio to gross receipts.

In Table III I give the working expenses of the three lines and the ratio to the gross receipts. Nothing has yet occured to show that with coal at 36*s*. 6*d*. a ton any of these lines can be usefully worked for less than about £E.90 per kilometre per annum.

The figures given by the Fayoum Company would appear to contradict this statement, but as their lines are still under construction the traffic has not reached its proper importance and the working expenses are abnormally low.

With a ratio of 55·8% of the gross receipt the working expenses of the Mansourah-Mattarieh Company have probably nearly reached their lowest limit.

The Delta Company with a system suddenly doubled has done exceedingly well in bringing the ratio of their working expenses down to 72%. With the present price of coal we may expect to see this figure still further reduced during the present financial year. The working expenses of the Fayoum lines are about the same as last year, but their proportion to gross receipts shows that the traffic is insufficient to be very profitable.

Lead of passengers and Goods.

The average lead for passengers on the Delta lines is only 12 kilometres (7½ miles). The average price paid for all tickets sold has increased on the Mansourah-Mattarieh lines, is the same as last year on the Delta lines, and has fallen on the Fayoum lines.

The lead for goods on the Delta and Fayoum lines averages 29 and 17 kilometres (18 miles and 10 miles) respectively, whereas on the Mansourah-Mattarieh line it is said to be nearly 35 kilometres (21¾ miles).

Where no station charges are made these short leads are fatal to economical working or high profits.

Coaching ratio.

No further steps have been taken this year by any of the Companies to reduce their passenger rates. The Fayoum Company has the lowest market rate, which works out at $\frac{7}{10}$ of a millieme per kilometre (0·28 of a penny a mile).

Number of passenger.

The passenger traffic on the Mansourah-Mattarieh line has exceeded that of last year by 25%, and the number of passengers per kilometre of this line nearly equals that of the Egyptian State Railways. The numbers of the Delta lines are well maintained, while on the Fayoum lines there appears to be a falling off in the coaching receipts per kilometre opened.

Rates for goods.

There is no change to report with regard to the minimum rates for goods. The lowest rates in force are on the Delta lines, 1·5 milliemes per ton per kilometre for transport of cotton stalks. The Fayoum Company charges 1·8 milliemes per ton per kilometre for transport of stones and manure.

Accidents.

Only one serious accident has been reported this year on these lines. An engine-driver failed to obey the signals given him and ran his passenger train into a catch-siding near a level-crossing. The engine was derailed and the driver killed.

DELTA LIGHT RAILWAYS.

From my report for last year it results that the Chemins de Fer Economiques lost during 1900 £E.9·5 per kilometre of line worked.

The Delta Company acquired the lines of the Economiques in September last, and after about nine months working show a net receipt of £38 per kilometre of the whole system.

This Company is in every way to be congratulated on such a satisfactory result.

The receipts from goods have been somewhat increased by an exceptional transport of 81,000 tons of stone for the Zifteh Barrage. This may be counted upon for the next twelve months only; but it is not the goods but coaching receipts which have assisted most to improve matters.

The transport of manure by rail in the Behera Province was practically stopped during the past three months in consequence of the new rules imposed by the Antiquities Department. The same Service taxes broken pottery at 100% on its value *in situ* and this has greatly restricted its use, and has stopped its transport.

We may fairly expect to have these matters righted before long, and the Delta Company's yearly receipts will be thereby benefitted.

FAYOUM LIGHT RAILWAY.

To thoroughly understand the chief cause of the poor kilometric receipts of this line the plan must be studied. The Tamiyah-Edwa and Mitirtaris-Rodah branches (33 kilometres) were completed in 1901 and are counted in the length of line opened to traffic, but in consequence of the non-completion of the Edwa subway, and of the branch from Gabala to Senouris through traffic to Senouris and Fayoum was prevented and this caused these thirty-three kilometres to be worked at a dead loss.

This and the heavy cost of the Edwa subway (said to be £E.7,000) has greatly embarrassed the finances of the Company. It is to be hoped that the Directors will take advantage of the generous treatment they have received at the hands of the Government and complete their lines without further delay, for although the venture has not hitherto proved very renumerative the lines are a distinct benefit to the Province.

The figures relating to the Fayoum Light Railways and entered in the annexed tables have been given me by the Manager of that Company. The Directors have promised to supply corrected figures which shew that the line has earned a little more than the manager's figures give. I have not up to the present received these figures, but the difference is not large enough to affect the deductions I have made, though the shareholders may be interested to know that the profits are slightly better than I have stated.

CONCLUSIONS.

An experience of five years shows that in constructing Agricultural lines (1) the best economy is not gained by following Agricultural roads and canal banks unless these are unusually straight, and (2) that curves of less that 100 metres radius should be studiously avoided, and (3) that transhipping platforms are seldom required and parallel lines for transhipping from truck to truck are more generally useful, (4) that transhipping of goods (generally considered one of the greatest drawbacks to narrow-gauge lines) is not costing the Companies more than 6 milliemes (1·47 pence) a ton for cotton and 20 milliemes (5 pence) per ton for coal in bulk.

On the whole, the fellaheen themselves have made but little opposition to the construction of these lines. In many cases they have shown remarkable foresight and enlightenment in having stations made on their own property. The few serious difficulties that were met with were caused almost entirely by the rich landed proprietors. It is often stated that the fellaheen are incapable of combining in order to carry out useful measures in the public interest. I am glad to be able to cite an instance to the contrary. In the Behera Province the Headmen of five small villages bought ½ a feddan of land from a poor villager and gave it to the Company, and when the station was opened they called it "Ettehad" which may be translated "Unity" or "Alliance."

The benefits afforded to the landed proprietors in a district like the Behera are incalculable. I was informed by the Omdeh of Delingat, a village about 25 kilometres from Damanhour, that before 1892 the transport of cotton to Damanhour cost 12 P.T. a kantar, and during the winter months it was almost impossible to get it carried at all. When the agricultural road was made, this rate was reduced to 8 P.T. per kantar, but transport was possible only while the weather left the road practicable. Now by the railway the rate is 4 P.T. a kantar and the cotton can be carried at any time; a most important matter.

Many stations are being rapidly shut in by buildings, chiefly of the Greek bakal class. If this is allowed to continue it will be very difficult and costly to obtain land for future extensions.

I suggest that it would be in the interest of the Government and the public, as well as the Company, to reserve the land around each station under certain conditions, as is done for the State Railways. The owners of this land have been benefitted so enormously by these railways, that it would be only fair for them to contribute in some small degree to the public interest. It is not, however, the present owners of the land who will profit most, but the European strangers, who at some future date will have to be bought out at extravagant rates.

I have to day (2nd January) received from the Directors of the Fayoum Company the corrected figures they promised me. They refer to eleven months—January, 1901, to November, 1901.

From them the following approximate figures may be deduced for the year 1901:—

	£E.	Mill.
Gross receipts per kilometre and per annum	92	800
Total expenditure	75	500
Net receipts	17	300

According to the printed report of the general meeting of shareholders held on the 10th December last it would appear that the net receipts of the railway between June and October were at the rate of £E.24 per kilometre per annum.

Taking these figures as correct, it is all the more amazing that the Company should find any difficulty in completing their lines and that the shares should be quoted at so low a rate.

I have the honour to be, Sir,

Your obedient servant,

A. J. COTTERILL.

AGRICULTURAL LINES.

Table No. I. DETAILS OF COACHING RECEIPTS. *Annual Report, December, 1901.*

Number.	TITLE OF LINE.	Average length of line opened to traffic during 1901.	NUMBER OF PASSENGERS CARRIED.					RECEIPTS.		Year to which figures given refer.
			First Class.	Second Class.	Third Class.	Total.	Passengers per kilometre of line opened to traffic.	Average sum paid for each ticket.	Total coaching receipts.	
		Kilometers. Miles.						Mill.	£E.	
1	Mansourah-Mattarieh ...	K. 109·8 M. 68·25	2,215	58,410	526,491	587,116	5,386	23·7	13,925	July 1900. June 1901.
2	Delta Light Railways (including Economiques)...	K. 735 M. 457	155,636	—	2,822,151	2,977,787	4,074	20·3	60,637	Aug. 1900. Sept. 1901.
3	Fayoum Light Railways...	K. 120 M. 74·6	5,089	—	381,427	386,516	2,996	14·0	5,867	Jan. 1900. Dec. 1900.

AGRICULTURAL LINES.

Table No. II. DETAILS OF PERMANENT WAY. *Annual Report, December, 1901.*

Number.	TITLE OF LINE.	Province.	Term of concession.	Date of concession.	Approximate length of lines mentioned in concession.	Gauge of lines.	Weight of rails.	Length of line opened December 1900.	Length of line opened during 1901.	Total length of line, December 1901.	Lines under construction.
			Years.		Kiloms. Miles.	Metres. Ft. ins.	Kilos p.l.m. Lbs. p. y^d.	Kiloms. Miles.	Kiloms. Miles.	Kiloms. Miles.	Kilom. Miles.
1	Chemins de fer de la Basse Egypte, Mansourah-Mattarieh ...	Dakahlieh	50	June, 1895	K. 100 62	M. 1·00 3′ $3\frac{3}{8}$″	K. 23·14 46	K. 109·8 68·25	Nil.	K. 109·8 68·25	Nil.
2	Chemins de fer Agricoles, Delta Light Railways (combined with Economiques ...	Behera Gharbieh Charkieh Dakahlieh Kalioubieh	70	March, May, 1896	514·5 319·7	0·75 2′ $5\frac{1}{2}$″	14·88 30 18 36·28	719 446·7	60 37·3	779 484	21 13
3	Fayoum Light Railways... ...	Fayoum	70	May, 1897	146·5 91	0·75 2′ $5\frac{1}{2}$″	15·88 32	92 57·16	37 23	129 80·16	39 24·2
		Total Kilometres... ...			K. 761	—	—	K. 920·8	K. 97	1,017·8	K. 60
		Total Miles			M. 472·7	—	—	M. 572·11	M. 60·3	632·41	37·2

AGRICULTURAL LINES.

Table No. III. GOODS AND COACHING RECEIPTS. *Annual Report, December, 1901.*

TITLE OF LINE.	Average length of line opened to traffic during 1901.	Goods carried.	Receipts from goods.	Receipts from coaching.	Total gross receipts including every-thing.	Gross receipts per kilom. of line including every-thing.	Total expendi-ture.	Annual working expenses per kilom. of line.	Annual net receipts per kilom. of line.	Ratio of working expenses to gross receipts.	Ratio of goods receipts to coaching receipts.
	Kilom. Miles.	Tons.	£E.	£E.	£E.	£E.	£E.	£E.	£E.	%	
1. Mansourah-Mattarieh Line	K. 109·8 M. 68·25	43,863	6,154	13,925	20,079	182·5	11,222	102	80·5	55	1 to 2·28
2. Delta Light Railways (combined with Economiques)	K. 735 M. 457	382,838	31,374	60,637	99,981	136	72,033	98	38	72	1 to 1·9
3. Fayoum Light Railways	K. 120 74·3	84,573	4,743	5,867	10,610	88·4	8,577	71·4	17	80	1 to 1·24

ERRATA

	Page.	Line.			
	91	11	Maximum	instead of	Minimum
Opposite	99	1	Plate I	,,	Plate V
	102	27	Badr	,,	Badî
	104	8	Nezlet	,,	Naglet
Opposite	108	1	Plate II	,,	Plate IV
	110	32	Silsila	,,	Silsita
	111	45	Zarzuriya	,,	Zarguriya
	111	47	Lahaiwah syphon	,,	Labaywa syphon
	112	22	Nezlet	,,	Naglet
	113	13	1897	,,	1980
	118	37	Sluice	,,	Shirce
	121	8	Interesting	,,	Intersting
	132	14	Rashwaniya	,,	Bashawniyah
	135	5	Hosha	,,	Woshah
	135	29	Sundry	,,	Sunday
	137	28	Khor	,,	Kher
	137	29	Khor	,,	Kher
	137	33	246, 206	,,	000,000
	141	16	Sohagiya	,,	Sohaguia
	141	17	Harafsha	,,	Harabsha
	142	35	To suppress 6,048.664 at 3rd column		
	142	Last	*carried forward,* 2nd and 3rd columns, 6,048.664 and 45,320.667 instead of — and 51,369.331		
	146	4	2,818.066	instead of	2,680.295
	166	10	80 centimetres	,,	80 per cent
	199	34	5 metres	,,	8 metres
	212	6	3rd Circle	,,	2nd Circle
	216	1 (foot note)	Charging	,,	Charging by
	226	18	Hod El Hagar	,,	Hod El Nagar
	364	19	Chute	,,	Chûte
	371	3	à les compléter	,,	de les compléter
	374	20	Composée	,,	composées
	383	13	Was as below	,,	Were as below